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ABSTRACT

The purpose of this manual is to acquaint both teachers and administrators of vocational and technical education with the principles and methods of fostering better leadership, communication, problem-solving, and decision-making skills as well as instituting cooperative models as a strategy for better preparing students to enter the world of work. The first unit addresses the major changes that have taken place in the U.S. economic system over the past several years. This unit points out how the concern for productivity and quality relies to a great extent on the input of workers both as individuals and groups. The remaining four units provide teaching materials to assist vocational educators in providing these new skills to students: (1) group processes; (2) communications; (3) leadership; and (4) systematic problem solving. Each unit contains the following parts: (1) introduction; (2) learning objectives; (3) conceptual materials; (4) exercises; and (5) references. (NLA)

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Developing Systematic Problem-Solving, Communications, and Group Process Skills for Secondary & Post-Secondary Educators

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Educator's Manual

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BACKGROUND TO MANUAL

Three years ago I had the opportunity to address a group of vocational and technical educators and administrators on the subject of the competitiveness of Indiana companies in the world marketplace and the future of work for Hoosiers. During the course of my presentation, I identified some of the major deficiencies that industry had to deal with if it were to survive. While I devoted a fair amount of time to the discussion of the technical and technological problems that had to be hurdled, I gave equal time to examining the weaknesses in our companies' social systems -- the men and women relied on to get work done. At the conclusion of my presentation, a member of the audience pointedly asked me how Indiana's education system was helping industry in its "hour of need." I answered the question in this way: "Although the state's educational system was doing a reasonably good job of training students to be technically proficient, I believe that it could be doing a much better job in preparing them with the problem-solving and interactive skills required by companies moving toward higher levels of performance." I further explained that vocational and technical education, as well as academic education, were deficient in this regard.

Shortly after this presentation, the ILMC became involved in a project, which is believed to be the first of its type. Funded by the State Board of Vocational and Technical Education, now the Indiana Commission on Vocational and Technical Education (ICVTE), the ILMC studied 30 Indiana companies, to identify the primary skill and knowledge deficiencies that both labor and management identified as hampering their progress at joint involvement efforts aimed at quality and productivity improvement. Both labor and management agreed that problem solving, decision making, communications and leadership led the list of deficiencies, which caused delays in their company's progress toward employee involvement, improved quality, productivity and competitiveness. Both labor and management agreed that they were not adequately prepared in these areas during the formative years of their education and training.

During the two years that followed the initial research, the ICVTE supported the ILMC in the development of methods and materials to assist teachers in providing students with the skills and knowledge that are directly transferrable from the classroom to the world of work.

This manual is one of the products of the ILMC's work. It is not the panacea. It is only a beginning. I am confident that as an educator you will tap into your knowledge and ingenuity, go beyond the material in the manual and create additional ideas, examples and exercises to better prepare your students to enter their future workplaces. Our state's industry is counting on you.

Robert J. Firenze
Executive Director, ILMC

INTRODUCTION TO THE MANUAL

WHY COOPERATION?

Many of you know that Indiana has been confronted with serious challenges over the past 10 years. One of the most pressing has been the erosion of its economic base. Many solutions have been offered to solve problems such as loss of jobs, stagnating productivity growth and attraction of new industry to the state. One of these solutions has been the introduction of cooperative models for quality and productivity improvement into the workplace. Many examples of employee involvement have become commonplace in Indiana companies and in many instances have had a significant impact on the employment security of Hoosiers.

A recent study by the Indiana Labor & Management Council, Inc. (ILMC), illustrated that both labor and management in many Indiana business organizations recognize the need to strengthen people's skills to be able to effectively participate in cooperative efforts aimed at improving quality and productivity as well as preserving employment. To meet this challenge, Indiana firms are spending a considerable amount of time and money training their workers in areas such as problem solving, decision making, communications, leadership and group processes.

Another conclusion of the ILMC study was that by modifying how they teach and encouraging the development of behaviors required by industry our state's teachers will be more effective in preparing students to enter the world of work.

PURPOSE OF THE MANUAL:

The purpose of this manual is to acquaint both teachers and administrators of vocational and technical education with the principles and methods of fostering better leadership, communication, problem-solving and decision-making skills as well as instituting cooperative models as a strategy for better preparing students to enter the world of work.

CONTENTS:

There are five major content areas of this manual. They are:

1) Work in the 1990s
2) Group Processes
3) Communication
4) Problem Solving
5) Leadership

The first unit addresses the major changes that have taken place in the American economic system over the past several years. It specifically talks about change as it relates to quality and productivity improvement efforts in industry. This unit also points out how the concern for productivity and quality relies to a great extent on the input of workers both as individuals and in groups. A number of new work-design strategies are identified and described.

One of the implications of the changes which are taking place, is that workers need skills that are not traditionally taught in school. These skills arise from the interaction of the sections in socio-technical systems: the human systems, technology and technical systems.

The skills needed to make these systems work are group processes, communication, problem solving and leadership. The importance of these skills comes from a study showing the changes taking place in Indiana's industry. Industrial leaders themselves were the source of information about current changes. At the end of Unit I is a summary of a research study examining industry needs as well as vocational and technical school activity in these areas.

The remaining four units provide teaching materials to assist vocational educators in providing these new skills to students. Each unit contains the following parts:

1) Introduction

2) Learning Objectives

3) Conceptional Materials

4) Exercises

5) References

This material should be sufficient to allow the student to become aware of the importance of these skills and develop some basic competencies in each. The exercises that are provided may be used as is or modified to suit situations in the school, classroom, shop or lab setting. Teachers may add new exercises as they become more experienced with the materials.

Comments to Instructors

General:

The overall intention for this manual is to present to educators a guideline for developing effective problem-solving techniques among their students. The context of participative problem solving offered here is worker-management groups. Group process and leadership affect that context. Communications is the medium of the problem-solving process. Each of the instructional units to follow contribues understanding facets of problem solving.

At the end of each of the following units is a section that will help the instructor tailor additional exercises — perhaps ones that will better suit specific teaching or student needs. Exercises in this text have been structured around certain content themes. Recognizing these will help instructors to build new, constructive exercises.

Justification: Throughout the exercises is a theme that emphasizes group participation in problem solving and decision making. Simply, "two heads usually are better than one." NASA studies have repeatedly shown that group-based decisions take into account more factors and considerations than individual decisions. When a number of people are affected by a decision, input from a number of problem solvers invariably is better than that of one person.

Information: More individuals in a problem-solving process bring more information and viewpoints to bear on the process than one person. As in brainstorming, information may excite or stimulate the search for even more information on which to base an eventual decision.

Sound information is the basis of effective decisions.

Motivation: Why is this approach necessary or useful? From the workers' standpoint, it increases job satisfaction, stimulation and enjoyment. The more they participate in workplace decisions, the more they get out of their work.

From the organizational view, the benefit is profit — which in turn can also benefit the employees. The organization gains by more effective production, reduced waste and increased employee satisfaction — which may result in employment security and lower turnover, burnout and absenteeism.

Students equipped to participate in collaborative workplace decisions will have an advantage over those who do not in finding work in the changing business and manufacturing setting.

Expected Outcome: All exercises must be seen with a view to the consequence or result of performing them. The underlying assumption for the exercises contained here is that

several consequences will come about if workers and managers help each other in the problem-solving process:

1. Problems in the work setting will come to light framed in positive, solution-oriented ways.

2. Problem solution alternatives can be looked at openly without prejudgment.

3. Problem solution alternatives will be tested in an unbiased manner.

4. Alternatives will be evaluated openly.

Finally, the joint problem-solving approach will be continuous.

UNIT I: WORK IN THE 1990s

Rationale: Understanding the changing nature of America's industrial system and the ramifications of these changes on the survival of industries and those employed in them, is of paramount importance to those who wish to be successful as they enter today's and tomorrow's world of work.

Objective: To acquaint participants with the changing industrial world and the new roles of labor and management in changing organizational cultures and in work redesign.

Student Learning: Students should be conversant with the idea that change is taking place in the American industrial system. They should also be aware that they will be expected to do more at work than just be concerned with the narrow confines of a single job. Finally, they should know that they will need to be competent at social as well as technical job skills in order to be effective workers.

Contents of this Section:

1) Introduction to Work in the 1990s

2) Examples of Modern Manufacturing Technologies

3) Productivity Improvement Strategies

4) Work Design Alternatives

5) Summary of Industrial and Vocational Education Study

6) Exercises

7) References

Part I – Introduction to Work in the 1990s

The 1980s may be characterized as a period when revolutionary changes became necessary to solve grave evolutionary problems affecting our nation's economic survival. In their quest to meet the challenges of quality and productivity improvement driven by unprecedented domestic and foreign competition, American companies are redesigning work to increase the effectiveness of their workers and to better utilize capital, energy and materials. These companies learned that quality and productivity improvement must be integrated into their day-to-day activities and management systems. They must become a strategic part of their organization's culture.[1]

Many of these changes have involved the innovative use of people in the workplace. Many techniques aimed at enhancing both organizational effectiveness and employee fulfillment are being used with considerable success. Traditional relationships between labor and management have been "us vs. them." Management believed that people had to be controlled and that it was responsible for setting goals. This view is increasingly giving way to a model of mutual commitment in which both labor and management work together toward the achievement of common goals.

The commitment model is based on the assumptions that people want interesting work and are capable of handling many responsibilities in a more open and trustful work environment. The commitment model is further characterized by a greater autonomy in the workplace and greater demand placed on workers' skills and knowledge. Employees exercise more voice about their work. In companies organized by unions, labor and management relations trend toward greater mutuality, and employment assurance becomes a higher priority policy area.[2]

As organizations replace traditional labor and management relations with those based on trust, commitment and mutuality, beneficicial developments materialize. Efforts are made by labor and management to move decisively to newer and higher levels of performance, thus creating necessary changes for the overall good of the organization. Traditional, bureaucratic, "Scientific Management" (F. W. Taylor, 1919) practices give way to increased employee involvement. Sharing gains in productivity, employee problem-solving and decision-making groups become common. Labor-management joint ventures in cooperative problem-solving and par-

1 A culture is the customs and social processes by which groups of people at particular times come to work together toward shared values and goals. An organizational culture, therefore, is one in which people use various materials and processes of the time to yield an intended product or service.

2 Walton, Richard E., "From Control to Commitment in the Workplace," *Harvard Business Review*, March – April 1985.

ticipative work designs become regular processes. The organization begins to look for ways to optimize its socio-technical systems.

The Socio-Technical System

Organizations are socio-technical systems. They consist of people interacting with technical systems and technology to transform raw materials into products or services, which enable an organization to be profitable.[3]

The Human (Social) System

The social aspect of the socio-technical system involves the organization's workers. Workers, as used in the context of this manual, are all the people in an organization, whether they are directly involved with the transformation process or whether they are performing managing functions. People interact with one another and in many cases depend on one another to do their jobs effectively. Consideration must be given to their values, attitudes, skills, knowledge, motivation, recognition, and rewards. The people in the organization (system) determine, to a very great extent, how work will be done and the culture in which work is conducted.

The Technical System

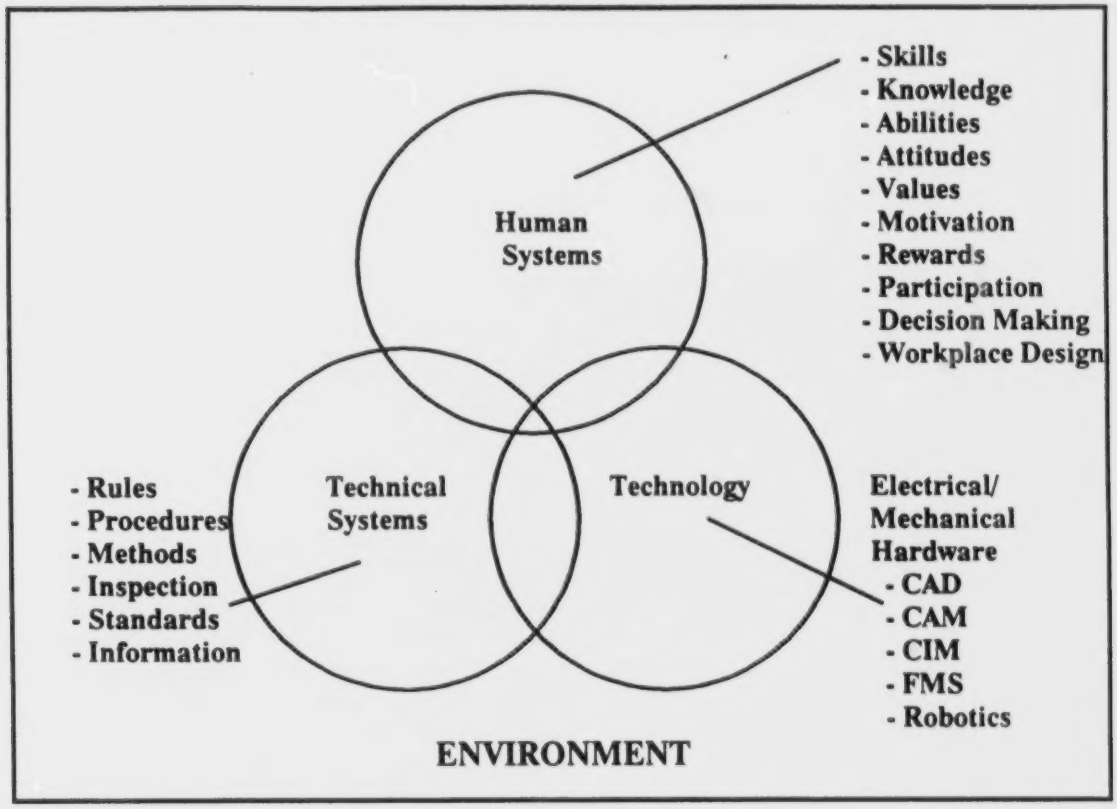
Technical systems are sets of tools, equipment and facilities as well as processes, methods, procedures, standards and instructions designed to support people and technology.

The Technological System

Technology is distinguished from technical systems because an infinite variety of technical systems may be designed from a given technology. As used here, technology is the electrical and mechanical systems and supportive software in the workplace used to make products or deliver services. (See Figure 1.)

3 Berniker, Eli, "Sociotechnical Systems Design: A Glossary of Terms," *Productivity Brief No. 25*, American Productivity Center, Houston, TX.

Figure 1
SOCIO-TECHNICAL SYSTEM



Why the Change

Forces, which are changing traditional work, also are changing technology, international competition, consumer demand for high quality products and services and workers wanting to contribute more to the work process. Each of these factors is worthy of a brief discussion.

Changing Technology – The Implications for People

Today, the proliferation of technology both in manufacturing and service industries is increasing at a high rate. In a work system designed to include advanced technology to improve quality and productivity, workers are required to possess the basic skills of mathematics, writing and science to perform maintenance, scheduling, quality control and other tasks related to their work. In high-performance organizations, whether or not technology is

dominant, workers often work as a team. If something goes wrong, they have the training to respond quickly to avoid costly break-downs or runs of wasted product. In this same work setting, the difference between service work and production work becomes blurred. Knowing how to work in a team setting is an important requirement for employment.

Competition

The traditional way we have sold goods is rapidly changing. Today, the United States and other industrialized countries must compete in a world market. To be competitive, these companies are compelled constantly to generate more value-added production. Achieving the goal of producing lower cost yet more sophisticated products, requires greater knowledge from those that conceive, design and ultimately produce the products.

Indiana is a case in point. Except for coal, the state does not have natural resources of its own to sell. It must compete in the marketplace by taking the resources from elsewhere, adding value to them and selling them to make a profit. To the extent that Indiana is efficient at this, and is able to produce high quality products and services for lower cost and at high levels of productivity, it will be able to keep or perhaps expand its share of the market.

Consumer Demand for Quality and Value

Today, Americans are placing greater importance on the quality of the products and services they buy. Products that once were looked upon as "good enough" or "ok, but not great" are losing out to those that meet the consumer's perception of "value." We need not look far to see the tremendous impact that high quality standards have had on the American consumers' buying habits. This accounts for high sales in automobiles, electronics, optics and many other items made in places other than in the United States. Buying foreign products weakens our industrial system and economy. But, telling someone not to buy high quality foreign products when a good alternative does not exist is not reasonable. Well then, what is reasonable? A reasonable solution is for our companies and those working in these companies to meet the challenge to change their traditional attitudes toward work and raise their level of product and service quality: to launch an all-out attack to regain consumer confidence, their fair share of the market, and quality employment, which will maintain a high standard of living.

Workers in today's American factories are rising to the occasion. They are working with their managements to establish high quality standards and produce goods which are of high value and dependability.

Workers' Concerns

Today's workers want more from work. They want to bring more of themselves to their work and participate more fully in it. These workers are not satisfied with being restricted to a "narrow" range of talents and jobs. They want and feel that they are capable of contributing more to the overall performance of their organizations. Today's workers also feel that they should share in the gains their company makes from quality and productivity improvement. Thus, alternative compensation systems are now being considered by management to attend to this issue. Workers want to be involved in solving the problems and making the decisions about work and the work process for which they are responsible. Last, but certainly not least, today's workers are most concerned about the security of their employment. Traditionally, most workers kept their jobs until they resigned or retired. It is different today. Now, employment is dependent on the competitiveness and profitability of the company for which they are working and the ability of workers to continually upgrade their skills and knowledge. As a company's market share shrinks, it is forced to downsize its operations and, in so doing, eliminate work and the workers who perform it.

Summary

In many companies today a noticeable management change is taking place, one which emphasizes individual contribution. Management is beginning to understand that objectives are established and achieved *with and through people*.

What is emerging is an industrial system that requires workers and managers to have a common vision of their company's future, to be more oriented toward determining and fulfilling customer needs, to derive authority from skills and knowledge rather than from a position in the organizational hierarchy, and to be trained to operate in teams rather than as solo experts. Thus, managers are required to listen to suggestions and to help workers learn how to identify and analyze problems of production, quality and distribution.

The involvement of employees in problem solving and decision making is a significant trend in the American workplace. It is a development which extends beyond the borders of the United States and encompasses all of the first world and much of the second and third worlds. Thousands of companies are discovering that properly established and operated initiatives involving employee participation increase productivity, work quality, worker satisfaction, employment security and organizational flexibility.

The development of successful employee involvement in problem solving and decision making requires a basic change in the way people within an organization relate to each other, think and feel about each other and deal with one another. Employee involvement becomes integrated into the total culture of a high-performance, high-involvement or-

ganization. Such a change requires a well-designed process of educational and social change and the commitment of everyone to make it work.

The vocational, technical and academic school educator plays a key role in preparing people for the social changes necessary for the security of their future employment and the profitability and growth of their future companies. Many avenues exist to train, educate and create situations that promote individual contribution, collaboration and consensus agreement. This manual is intended to provide teachers with the means to meet these objectives.

Part 2 – Examples of Modern Manufacturing Technologies

In recent years, there has been an increase in the use of technology in American industry. It should be pointed out that technology does not have to be complicated and expensive to be useful. Simple automation that helps people move materials or products or reduces unnecessary stress during work (such as special tools) are examples of simple technology. Advanced manufacturing technology is both expensive and complicated and includes:

Computer-Aided Design (CAD)

In its simplest form, CAD is nothing more than an electronic drawing board. In its advanced forms, interactive computer graphics enable engineers and drafters to work in two or three dimensions by means of a light pen.[4] CAD systems also generate process instructions or programs for automatic machine tools together with bills of materials.[5]

Computer-Integrated Manufacturing (CIM)

The challenge to integrate CAD systems with other computer-aided functions has led to the development of a computer-integrated manufacturing system. In these, CAD systems are linked via a network of computers with other manufacturing and business systems, such as planning and tool design, manufacturing resources planning and financial performance reporting (Hubbard, 1987; Kegg and Carter, 1982).

Computer-Aided Manufacturing (CAM)

Computer-aided manufacturing in its simplest form involves the use of computers to guide numerically controlled (NC) machine tools. Modern machines equipped with automatic tool changes are able to perform a wide variety of functions, such as drilling, boring, tapping and reaming without the need for operator intervention or movement of the work piece to a different machine.

4 Cummins, Thomas C., and Blumberg, M., *New Manufacturing Technology and Work Design*, University of Southern California, 1986.

5 Cummins, Thomas C., and Blumberg, M., *New Manufacturing Technology and Work Design*, University of Southern California, 1986.

Robotics

According to the Robotics Industries Association, a robot is:

"A reprogrammable, multifunction manipulator designed to move material, parts, tools, or specialized devices through variable programmed motions for the performance of a variety of tasks."

Robots have been used primarily in manufacturing for unpleasant, hazardous or monotonous tasks where worker turnover and product quality tend to be problems. Today, robots are being used in welding, spray painting, material handling and many other operations.

Part 3 – Quality & Productivity Productivity Improvement

Achieving high levels of quality and productivity requires:

- **A technically trained and educated work force.**
- **Workers possessing skills in problem solving, decision making and communication.**
- **Innovative, enlightened and efficient use of plant, equipment, materials and work force.**
- **Appropriate technology.**
- **Intelligent use of financial and human resources.**
- **Well-designed and well-integrated technical systems which support the optimization of technology and people.**

Productivity is defined as the efficiency by which physical resources are transformed into products or services. It depends on all the resources that go into its creation. Specifically, these resources are labor, capital, energy and materials.

Quality is a term best defined as the continuous anticipation, identification, and meeting of a company's internal and external customers' needs.

Productivity is a process. As the word is used in this manual, productivity is a *strategic* process. That is, it is an overriding, long-term, value- and goal-directed approach to reaching the intentions of the organization, be it service or manufacture.

In order for productivity to be realized as a strategic process it must:

- **Be integrated into the day-to-day activities and management systems of the organization.**
- **Become institutionalized. It must become an operating norm and a strategic part of the organization's culture.**

What is the role of education in productivity improvement?

Education plays an important role in the future of America's industrial system and its competitiveness in the world market. The educational process must continue to provide workers who possess basic quantitative, analytic and scientific skills. But industrial leaders are saying now that the schools must also produce individuals who are skilled in problem solving, decision making, communications and leadership. Furthermore, they must also understand the basics of economics, the process of quality and production improvement and the great reliance which will be placed on them to contribute to the overall performance of the companies they will work in.

How Are Indiana Companies Meeting the Challenge?

In 1988 the ILMC conducted a survey of 600 Indiana manufacturing companies to acquire a basic understanding of the efforts that they are making in the area of quality and productivity improvement. The three major groups of strategies the companies were and are using fall into the categories of: **social system improvement**, i.e., making jobs more creative and skill demanding; **technical systems improvement**, i.e., actions aimed at improving information management, work standards and materials management; and **technology improvement**, i.e., using conveyors to minimize non-value added materials handling or robots for monotonous work. The results of this survey depicted Indiana manufacturing as progressive in its attempt to be competitive. Progressiveness was substantiated by the following findings:

1) Ninety-one percent of the companies indicated that they will place greater emphasis on improving their total performance over the next five years.

2) Of the companies surveyed, 71.6 percent reported that management consults both formally and informally with hourly employees about the selection and implementation of productivity and quality improvement strategies.

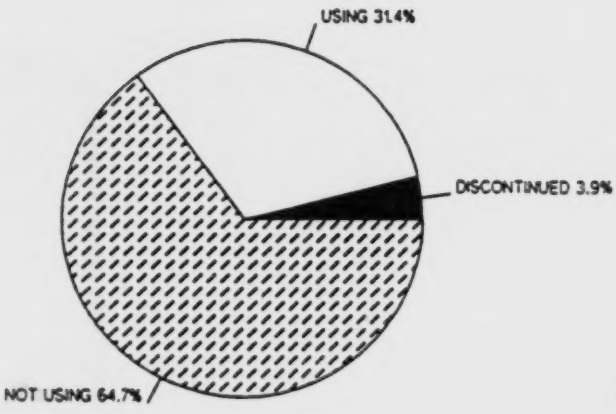
3) Thirty-four percent of the companies have adopted the strategy of job enlargement where their hourly employees are cross-trained to perform more than one job

4) Thirty-one percent of the companies are using job enrichment strategies to provide their employees with greater freedom to make decisions relating to how they do their jobs.

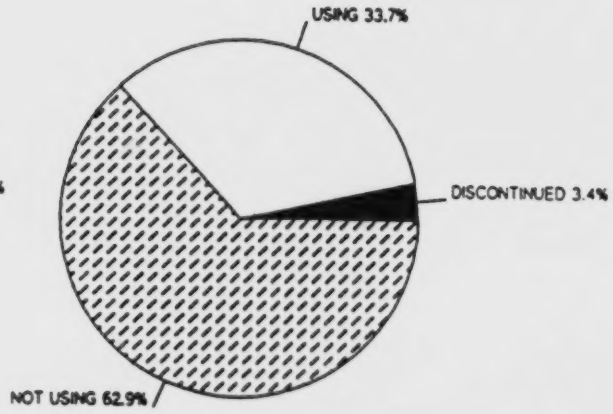
Figure 2 illustrates various work innovative strategies companies are using to improve their quality and productivity. Figure 3 illustrates technical and technological strategies and Figure 4 illustrates an example of one of the fastest growing structural strategies -- productivity gainsharing.

Figure 2
Work Innovations

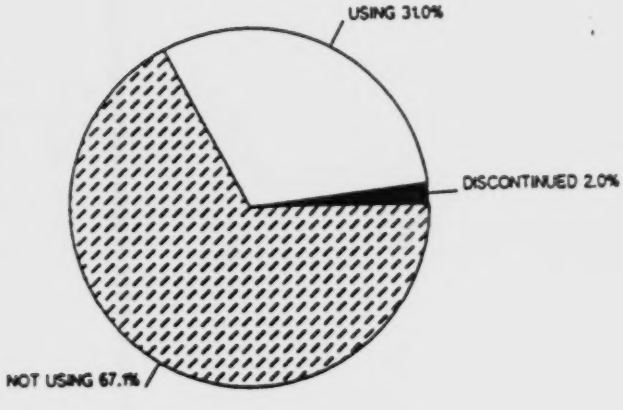
Job Enrichment



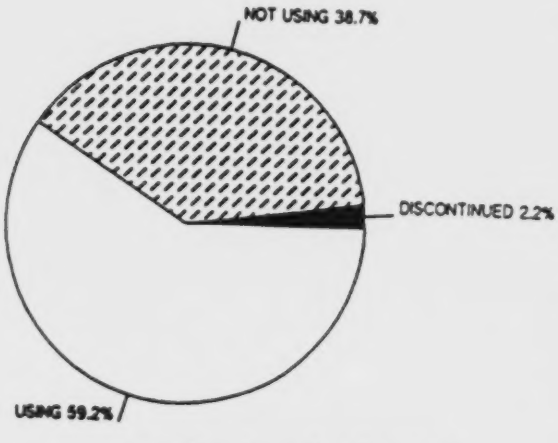
Job Enlargement



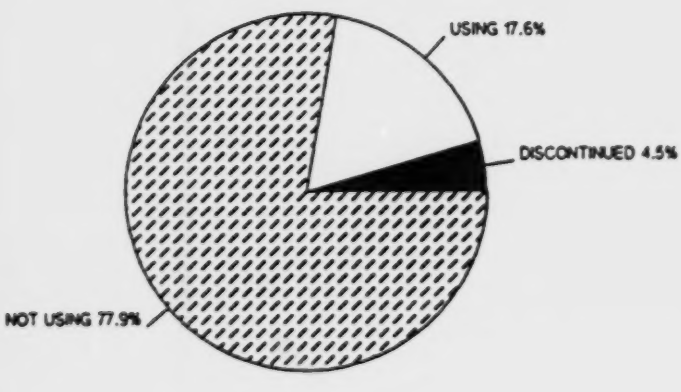
Job Sharing



Job Rotation



Self-Managing Work Teams



Other Employee Involvement Strategies

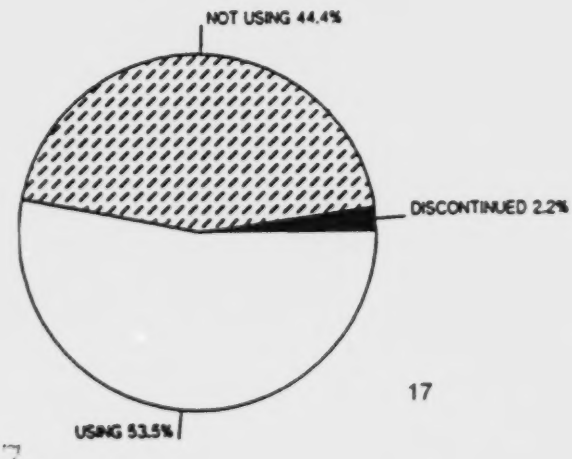


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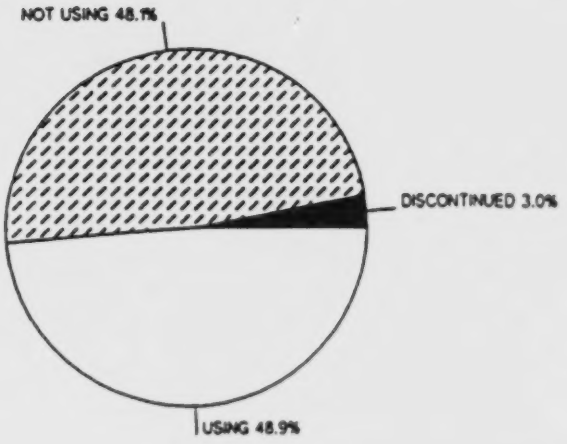
Figure 3
Technical Strategies

Statistical Process Control



Just-In-Time Production Methods

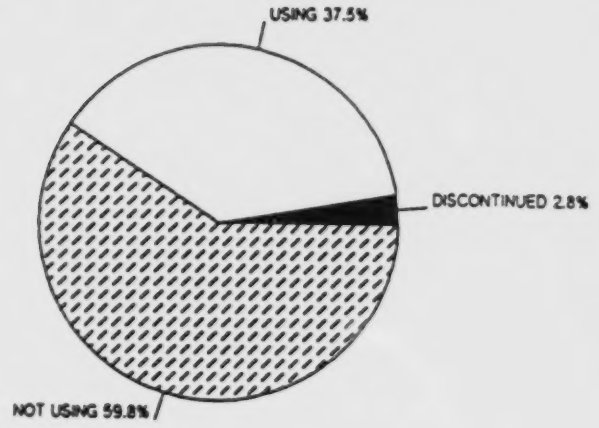
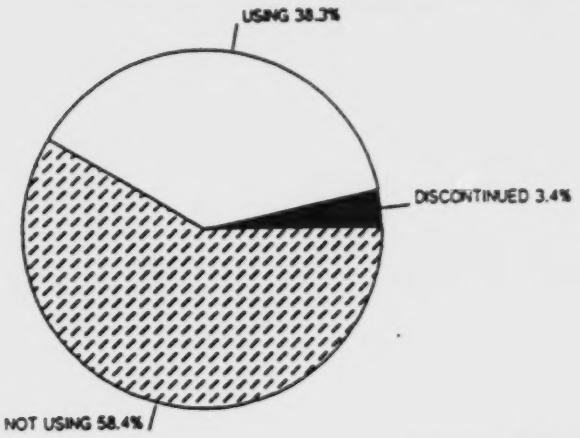
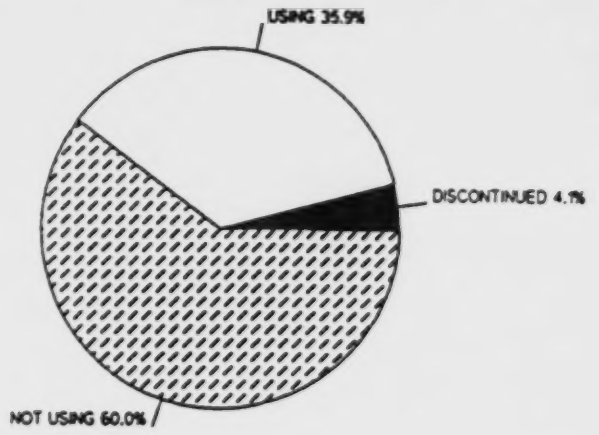


Figure 4
Technological Strategies

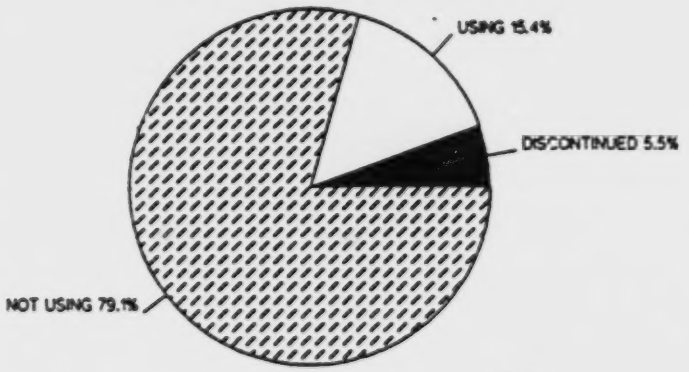
Computer-Aided Manufacturing



Computer-Aided Design



Automated Materials Handling

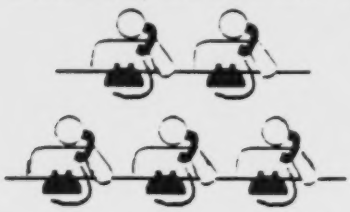


Part 4 – Work Design Alternatives

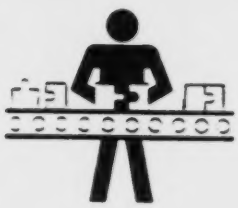
Work design/redesign is a creative process aimed at improving the quality of working life of workers while increasing the performance of the system. Management, working with labor is challenged to expand the roles of people and increase skill levels and decision opportunities so as to place variance identification and control at the operating level of the organization.

Examples of work design alternatives include both individual job designs and group job designs.

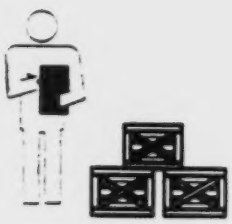
Individual Job Designs – are selected when technical interdependence and technical uncertaintly are both low. These designs include:



1) **Job Sharing** – where people or groups share work assignments



2) **Job Rotation** – where the individual's job remains the same but the worker rotates through a number of different nonsequential tasks.



3) **Job Enlargement** - increasing the number of different elements a worker performs in sequence during the process of making a product or processing information.

4) **Job Enrichment** – where employees are given greater freedom to make decisions concerning the way their work is performed.

Group Job Designs – include consultative and decision-making groups. Group designs are selective when both technical interdependence and technical uncertainty are high.

A. Consultative Groups

Employee Involvement Groups

Employee involvement groups are used on a large scale by organizations as part of efforts to increase productivity, improve quality, enhance quality of work life, and promote employee participation. One of the most common employee involvement designs is a labor and management problem-solving group or task force.

1) **Problem-Solving Group** - A problem-solving group is a small group of employees from a common work area who get together regularly to identify and generate solutions for problems they encounter in their work situation.[6] This group is designed to give people an opportunity to:

   - use their creative talents to improve the quality or their products and services
   - improve quality and productivity
   - change their attitudes about work

   Problem-solving groups were among the first of the employee involvement strategies and served a useful purpose. Today, many companies are expanding the scope of these structures into more complex forms of employee involvement such as self-managed work teams.

2) **Safety Circles (Task Forces)** - Safety circles are used by some companies to reduce the number of accidents and injuries by keeping safety and all its important features foremost in the minds of the employees. This design implies a change in the employee's role from passive to active, while management's role becomes less negative (fewer don'ts) and is more positive.

   The safety circle has impact on reducing the number of injuries due to accidents by channeling the talents, knowledge and experience of workers toward the identification, evaluation and control of hazards in the work place.

   Many manufacturing and service companies are combining work cells with employee involvement to obtain high productivity, quality and continuous improvement.[7]

6 Mohrman, S., *The Quality Circle and Its Variations*, U.S.C., August 1987.

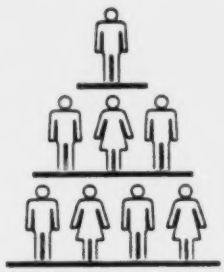
7 According to William F. Hyde in *Classification, Coding, and Data Base Standardization*, Marcel Dekker, 1981, a manufacturing cell is a technique for manufacturing small to medium size batches of parts of similar process, of somehwat dissimilar materials, geometry and size, which are produced in a committed small cell of machines that have been grouped together physically, specifically tooled and scheduled as a unit.

B. Decision-Making Groups

This form of work design places the responsibility for putting into effect the solutions group members have devised for problems within their jobs or group of jobs' responsibility. Examples of decision-making groups include:

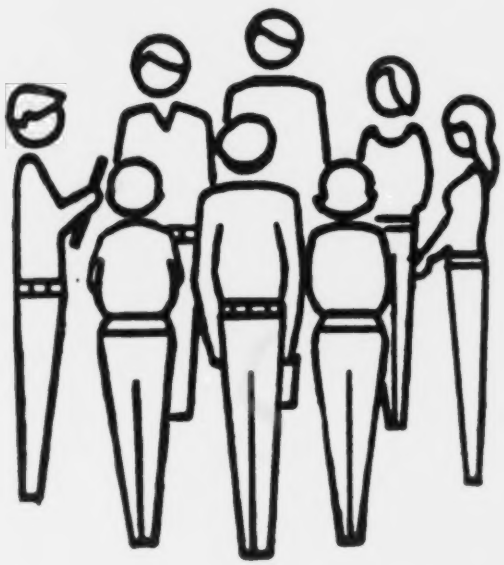
1) **Natural Work Teams**

A fundamental work unit, which consists of co-workers who share a common leader and common unit mission or purpose, that requires a degree of interaction based on interdependence.



2) **Semi-Autonomous Work Teams (Self-Managed Work Teams)**

Natural work teams that become more self-managing or autonomous are frequently called self-managing work teams. The self-managed work team has the responsibility for a significant area of the work place and it can make a number of decisions concerning when and how the work will be done.



Summary of Industry and Vocational Education Study[8]

The ILMC responded to a request by the Indiana Commission on Vocational and Technical Education to study two questions. The first question concerned determination of the needs of Indiana businesses about the quality and productivity improvement programs that rely on worker involvement. The second question concerned the specific activities that are taking place in the vocational schools to meet these needs.

In order to answer these questions, a two-phase research study was conducted.

Phase I

In the first phase, a sample of 30 Indiana businesses was identified. Businesses were chosen if they currently used some form of worker involvement program. These firms were from different geographic regions of the state.

A survey instrument was developed asking managers in these firms about the skills they felt workers needed to participate in their quality and productivity improvement initiatives. Managers were also asked to what extent workers possessed these needed skills. They were asked to describe the training provided to workers.

The results of the first phase of the study led to the following conclusions:

1) Workers need extensive skills in the following areas:

   a) Group processes

   b) Communications

   c) Problem solving

   d) Leadership

2) The typical worker does not possess a sufficient level of these skills to participate in these programs without considerable training.

8 *To Promote Worker Involvement through Vocational Training and Education*, Indiana Labor & Management Council, Inc., September 30, 1985.

3) Indiana firms spend a considerable amount of money each year training workers in these skill areas.

Managers in the same firms were asked about the role that they saw for vocational and technical education in preparing workers for their function in modern organizations. Again, a number of responses were received. They were:

1) Schools are doing a good job teaching technical skills.

2) Schools are probably not teaching the problem solving and social skills in a systematic way.

3) Firms are willing to cooperate with schools to develop programs to introduce these skills into the curriculum.

4) Specific activities could be used to teach these skills to students. (See Table 1, Page 25.)

Phase II

The second phase of the study involved the survey of 22 vocational and technical schools in the state. Again, these were geographically dispersed around Indiana. A second survey instrument was developed for the schools.

There were two main questions that were asked in the schools: Whether educators were aware of the needs of industry with respect to non-technical skills, and whether or not these skills were being taught in a systematic way. The conclusions drawn were:

1) The administrators are aware of the changes taking place in the workplace with respect to quality and productivity.

2) The skills that are focused upon by the schools are primarily technical ones.

3) The social and interactive skills are not taught in a systematic way by the vocational and technical schools.

4) The administrators do not feel that their industrial counterparts have voiced a strong enough need for this kind of training and education.

Compare the findings of Phase I and Phase II. Table 1, page 25, displays the responses of 30 managers of Indiana businesses. Clearly, they express the idea that cooperative, collaborative group processes in problem-solving experiences are essential in developing workers' participation in workplace operations. They volunteered that teaming and group involvement are especially important to cooperative efforts. Of the 24 categories of recommended skill areas needed to achieve labor and management mutuality in the workplace,

only five could be construed to be technical skill categories. All else were *social or human relations* issues. Keep in mind, all the categories were volunteered by the managers; they were not prompted by the survey questions.

Conclusion

For the purposes of this manual the main implications of the research described is that some important areas of training need to be included in the existing curriculum of vocational and technical schools. The remainder of this manual provides some tools for vocational and technical educators to implement this training.

Table 1

Recommendations from Managers for Activities Preparing Vocational Students to Participate In Cooperative Labor/Management Programs

Recommendation	Frequency[b]
(P) Team Projects	16
(P) Role Plays	8
(P) Use of Quality Circles to Solve School Problems	7
(P) Field Trips	7
(P) Public Speaking/Presentation Skills	6
(P) Multi-Stage Projects Requiring Cooperation	6
(P) Real World Experiences	6
(P) Internships	5
(P) Case Studies Using Quality Circle Methods	5
(P) Work Experience in School	4
(P) Use of Junior Achievement Model	4
(P) Values Clarification Training	3
(P) Assertiveness Training	2
(P) Listening Skills	2
(P) Team Sports	2
(P) Teach Teacher about Cooperation	1
(P) Use of Quality Circles for Developing Curriculum	1
(C) Group Dynamics	15
(C) Teach Problem-solving Process	9
(C) Presentations by L/M on Cooperation	6
(C) Teach About or Structure Decision-making	2
(C) Teach About Statistical Process Control	2
(C) Communication Skills	2
(C) Advisory Board From Labor/Management	1

P = Process Experiences
C = Content/Knowledge

[b]These are the number of times these items were mentioned. Some respondents mentioned more than one suggestion.

Part 5 – Summary of Unit I

In this unit, an attempt was made to familiarize the vocational and technical educator with the changing world of work and the challenges that lie ahead for students. They may soon become part of work systems that are drastically different from those of the past. Implicit in the material is the fact that preparing students with technical skills is not enough to enable them to survive in companies that are constantly seeing ways to improve their competitive position. Additional skills are mandatory. Some of these skills are social and include leadership and the ability to communicate ideas. Others are critical skills in problem identification, problem-solving and decision-making.

As indicated in the discussion on modern work design alternatives, workers must be able to contribute all their skills and knowledge to the overall performance and success of their organizations, if they wish to enjoy a work life where their employment is secure and their standard of living reaches their level of expectations.

Part 6 – Exercises

Students are assigned to contact a company in their area which has adopted one or more initiatives for quality and productivity improvement. They are required to:

1) Identify the company's technical and social initiatives.

2) Gather information about the purpose, operation and results from these initiatives.

3) Give an oral report to the class on their findings.

Teacher Responsibilities:

1) Show video tapes on employee involvement and self-managed work teams (see references).

2) Invite members of labor and management to school to "showcase" their initiatives for quality and productivity improvement with emphasis on their labor and management cooperative efforts.

3) Arrange and conduct site visits to local or nearby companies that use self-managed work teams to see how the process is conducted and what the effects are.

4) Apply a simulation about collaborative labor and management efforts (see references).

Part 7 – References on Work In the 1990s

Books:

Best, Fred, *Work Sharing Issues, Policy, Options and Prospects*, W. E. Upjohn Institute for Employment Research, 1981.

Hinrichs, Ph.D., John R., *Practical Management for Productivity*, Van Nostrand Reinhold Co., 1978.

Meier, Greta S., *Job Sharing*, W. E. Upjohn Institute for Employment Research, 1979.

Rosow, Jerome M. and Zager, Robert, *Employment Security in a Free Economy*, Work in America Institute Policy Study, Pergamon Press, 1984.

Rosow, Jerome M., *Productivity Prospects for Growth*, Van Nostrand and Reinhold Co., 1981.

Rosow, Jerome M., and Zager, Robert, *New Work Schedules for a Changing Society*, Work in America Institute.

Video Tapes:

Discovering the Future – The Business of Paradigms, presented by Joel A. Barker, dist. by Video Publishing.

High Productivity – How Matsushita Does It, presented by Keizai Koho Center, Japan Institute for Social and Economic Affairs, dist. by Encyclopaedia Britannica Educational Corp., 1980.

Improving Productivity Through Employee Involvement, presented by The Budd Co., dist. by Encyclopaedia Brittanica Educational Corp., 1984.

Just-in-Time/Just-in-Case, presented by Richard D. Schonberger, dist. by Encyclopaedia Brittanica Educational Corp., 1987.

Robotics: The Future Is Now, presented by William Shatner, dist. by Aims Media.

Stein on Creativity, presented by Morris I. Stein, Ph.D.

Team Excellence, presented by Walter Cronkite, CBS, Inc., dist. by Video Publishing House, Inc., 1986.

The Re-Making of Work Smarter Together, dist. by Encyclopaedia Brittanica Educational Corp., 1983.

The Re-Making of Work Responsibility Shared, dist. by Encyclopaedia Brittanica Educational Corp., 1983. Otis Elevator - Quality Circles, Indiana Labor & Management Council, Inc., 1987.

Why Quality, presented by John Guaspari, dist. by American Management Association, 1987.

Audio Tapes:

Peters, Tom, *The Excellence Challenge*, dist. by Nightengale-Conant Corp., 1984.

Peters, Tom, *The New Masters of Excellence*, dist. by Nightengale-Conant Corp., 1986.

Simulations:

Baker, R.D., Firenze, R.J., and Firenze, R.E., *Master Circuit Assembly*. Indianapolis: Indiana Labor & Management Council, Inc., 1989.

Lytle, William O., *The Flying Frisbee Factory*, dist. by William O. Lytle & Associates, 1983.

Unit II – Group Processes

Rationale: An understanding of the group process is a necessary part of applying any of the new initiatives for quality and productivity improvement. The group process is the foundation. The problem-solving activities following later in this manual are built on this foundation.

Objectives: To become aware of the importance of groups' ability to accomplish their goals. Also, to learn the importance of participation in the implementation of decisions and finally, to learn the brainstorming process as an example of group problem-solving.

Student Learning: As a result of this section students should be able to participate in a group decision-making activity.

Contents of this Section:

1) Need statement

2) Background material

3) Exercises

4) References

Part 1 – Need for the Understanding of Group Processes

The use of problem-solving teams is an effective way to improve quality and productivity. The traditional approach of the American educational system is to emphasize individual performance. While this has advantages for learning certain skills, it does not put students in a position to function very well in problem-solving groups or in work teams.

The result of this situation is that companies that have introduced problem-solving teams have had to spend considerable time and money teaching people the basics of group development and interaction. Without a basic knowledge of group dynamics, these teams have not been able to change their behavior.

Problems occur when attempts to change behavior are directed at individuals alone. In fact, group influence over individuals is very strong. In some organizations, for example, management has tried to use individual incentives to increase worker performance. These attempts have often failed because the group's common belief to restrict performance is often more powerful than a monetary incentive. Similarly, individual suggestion plans often do not work in settings where there is a strong group distrust of management.

Student behavior in school settings often follows similar patterns. Teachers and administrators trying to affect student behavior often view students as separate entities when, in fact, the key to behavior change lies in dealing with individuals as part of a group. They should be attempting to modify or change the behavior of the entire group. Team approaches to discipline, safety or academic performance have the advantage of group enforcement and can be very effective if properly implemented.

In order to be effective at this process, certain knowledge is needed. First, the process by which groups develop is needed. It must be understood that there are specific stages all groups must go through if they are to be effective. Second, the process of brainstorming must be learned and practiced. Once the brainstorming steps are integrated into an overall problem-solving model, a group may be very effective in dealing with the problems it may confront.

One of the keys to effective groups is an understanding of the use of consensus decision-making. Again this is a process unfamiliar to many and requires practice to be effective.

Part 2 – Background Material

Group Behavior and Processes

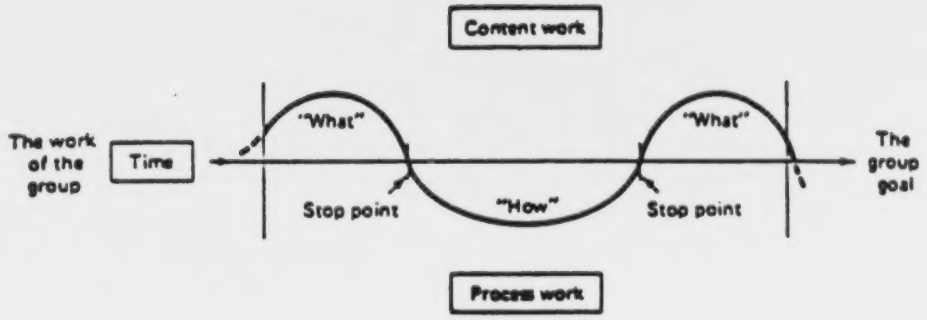
With the new emphasis on productivity and quality in organizations, the use of small groups to solve problems has grown considerably. It is important to understand how groups form and to identify the factors that lead to increased group performance. Table 2 shows the stages that groups go through.

Table 2
Stages of Group Development

STAGES	TYPICAL CHARACTERISTICS
1) Mutual Acceptance	Making Acquaintances Sharing Information Discussion of Subjects Unrelated to Task Testing Each Other Defensiveness, Quibbling
2) Communication and Decision Making	Expression of Attitudes Norm Establishment Goal Establishment Open Discussion of Task
3) Motivation and Productivity	Cooperation Member Involvement in the Work Creativity
4) Control and Organization	Interdependence Task Assignment Based on Ability Spontaneity, Flexibility

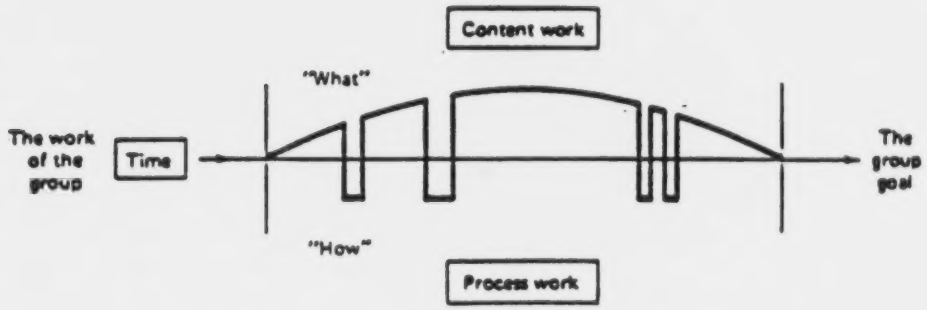
As groups move through these stages, two kinds of work take place: content work and process work. The content work is the task or problem that concerns the group, be it a quality or production problem. The process work is the activity focusing on how the group is accomplishing the content. In young, less mature groups this content and process activity generally does not take place at the same time. In fact, the content work slows and stops during process times as shown in Figure 5.

Figure 5



As groups become more mature, the time taken for the group process does not negatively affect task performance as shown in Figure 6.

Figure 6



Groups do not necessarily always achieve this ideal configuration of process and content activity.

It is important that both the process and content work of groups take place. Groups that do not engage in process work will often become stagnant and not reach their full potential. Group cohesiveness is one outcome of effective process work. Highly cohesive groups can be the most productive.

High cohesiveness when paired with acceptance of organizational goals, leads to the highest productivity as shown in Table 3.

Table 3
Relationship Between Group Cohesiveness, Performance Norms and Group Performance

		Cohesiveness: HIGH	Cohesiveness: LOW
Performance Norms	HIGH	High Productivity	Medium Productivity
	LOW	Very Low Productivity	Low Productivity

It can be seen that if the group has a high level of cohesiveness and the group wants to do a good job, then it will have the highest performance. If the group has high cohesiveness, but is not interested in doing a good job, then it will have the lowest performance. Groups with low cohesiveness will have a performance that falls somewhere in between the first two situations.

The real key to having successful groups in the workplace takes two things. The first is to make sure that the members like each other (have cohesiveness). The second is to make sure groups want to have the company succeed (have high performance norms). The way to bring about these conditions is through training and education. One important aspect of training is to learn about group decision-making.

Group Decision Making

Decision making has always been seen as an activity of management. Today, however, there is a growing belief that the people closest to the work itself are the best suited to make decisions about that work. The traditional decision makers, middle managers, often say that one of the reasons why it is not a good idea to allow lower level people into the decision process, is that participative decision-making takes too long. People making this argument look only at the time element in reaching the decision. They ignore other important factors. Table 4 shows some of these other issues.

Table 4
Comparison of Decision Approaches

	Leader Approach		
	Leader Directed Only	**Group Decision With Leadership**	**Group Decision Without Leadership**
Time to reach decision	Short	Moderate	Very Long
Time to develop commitment to the decision by the group	Long	Short	Short
Time required to implement the decision	Long	Short	Moderate
Expected total time	Very Long	Moderate	Long

If this table is studied, it can be seen that the total time to complete the process is what is really important. The table shows that a group process with some leadership is the approach that will probably have the shortest total time to go from decision to implementation. It can also be seen that a group working without a leader is not the best situation either.

It also must be realized that if a group is to be effective, it must possess the skills to work together to solve problems. The skills to approach problems effectively usually involves two parts. The first is the understanding of a problem-solving model, such as the one presented earlier; the second is the use of techniques to get people to present their ideas.

Probably the most common technique for getting ideas out is "brainstorming." The rules of brainstorming are as follows:

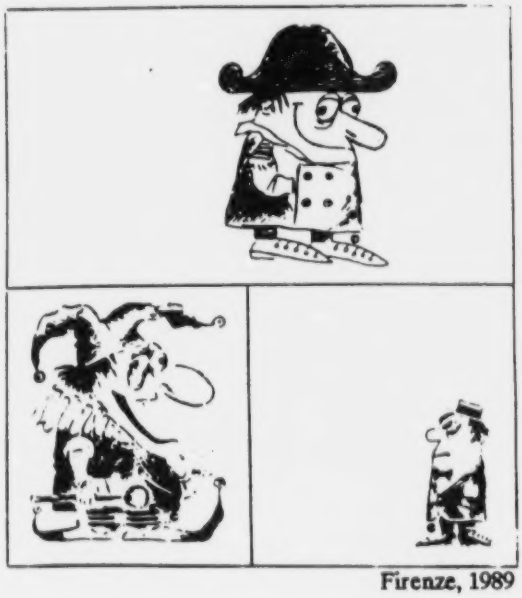
Rules of Brainstorming

1) Each group member is asked to contribute an idea.

2) List each idea, even if the same or a similar idea has already been posted.

3) Everyone should be asked explicitly to contribute: "George, do you have an idea to add?"

4) Record ideas as quickly as they are stated, using newsprint or chalkboard and writing so that everyone in the group can read each idea; do not just have one person taking notes.



Firenze, 1989

5) Encourage group members to contribute more ideas when they slow down or begin to "run out of gas."

6) Encourage funny, silly or seemingly foolish ideas; such ideas are often the most creative, and can frequently be made into practical ideas. Besides, brainstorming should be fun!

7) Make sure, before stopping, that ALL possible ideas are heard and posted. The leader might say something like: "Let's go around the room and make sure that we have thought of everything."

8) The leader should use "dead" time, time just before stopping, to add his own ideas that he was too busy recording to have contributed earlier.

9) Encourage group members to "build," "add to," or "expand on" ideas already contributed. This does not mean discussing ideas in any way; it refers to contributing additional ideas.

10) Finally, the MOST IMPORTANT rule of brainstorming: No one must be allowed to evaluate the ideas of others while they are being expressed or written down by the leader. If this happens, in either a negative OR a positive way, the leader should ask the one evaluating to add another idea to the list, thereby channeling such participation into a contribution.

Once ideas are generated and discussed, an alternative for action must be chosen. The use of consensus decision making is important at this point.

Consensus

Generating agreement among group members is another important aspect of group process. After ideas are discussed, one alternative often must be chosen. It is important for all members to feel that their voice is important in the process. Consensus is often a better way to do this than other methods, such as voting.

A consensus decision is one in which all members of the group are willing to try. It may not be everyone's first choice but:

1) Everyone has been heard and

2) Everyone can live with the decision.

The following rules apply to consensus decision making:

1) Get all ideas out (brainstorming).

2) Allow time for discussion.

3) Listen with an open mind.

4) Be willing to compromise on original positions.

5) Do not vote.

6) Do not argue.

Groups using a consensus approach are less likely to have members who feel that they have "lost" on an issue. People who feel that they have lost may be less enthusiastic about putting the group's solution into action. A consensus process can help groups be more effective in all stages of problem-solving.

Part 3 – Exercises

Exercise 1[9]

Title: Brainstorming

Purpose: The purpose of this exercise is to provide a practice session using a concept that "everybody already knows." It is a simple concept to understand. Most people think they know it quite well. Admittedly, most people probably do. The point is, even though they *know* it well, when asked to demonstrate it behaviorally in a small group, people usually do not *do* it well. This explains, in part, why research studies often failed to demonstrate the superiority of brainstorming over the procedure of just adding up individual ideas. That is, while conceptually simple, effective brainstorming involves skills on the part both of group members and leaders. These skills must be learned and practiced. Effective brainstorming is more than just following a simple set of rules and guidelines.

Summary and Rationale: The main activity is to have people actually use a specific procedure to solve a problem. It is only with practice that the use of brainstorming really becomes effective. This exercise provides practice in brainstorming skills.

Time: Twenty minutes to one hour.

Materials: Chalkboard or flip chart.

Procedure:

1) Explain briefly the concept of brainstorming. Indicate that a small group can learn, with some practice, how to pool its creativity in order to come up with more and better ideas than they would if their individual ideas were merely added up.

2) Review the structural rules for brainstorming listed on the "Brainstorming Rules" sheet, page 36. Allow time for questions and discussion. Do not proceed until everyone understands the rules.

3) Select a topic for brainstorming. A "real" topic of concern -- a problem -- might be the focus. For example:

9 This exercise is adapted from *Organizational Behavior: Concepts and Experiences* by Marshall Saskin and William C. Morris, Reston Publishing, Reston, VA, 1984.

- "How can we improve staff relations?"
- "How can we get everyone to come to class on time?"
- "How can we get students more involved in school decisions?"
- "How can we get class members to participate more, in any class we are in?"
- "What are the criteria for evaluating classes in this high school?"

Or the focus might be on generating solutions to the case at the end of this chapter. Any agreed-upon topic is appropriate.

4) Begin the brainstorming period. Normal time for this activity is about 20 minutes, but this may vary, depending on the topic.

5) When no more ideas can be elicited, formally stop the brainstorming process and begin the closure discussion.

Variation: Rather than the instructor leading the brainstorming discussion, group members can act as brainstorm leaders. To maximize this opportunity, switch leaders every five minutes or so, until at least several group members have had a chance to lead the brainstorm activity.

Discussion Questions:

- What are the next steps after all of the ideas are "out on the table?"
- Did you find it difficult to avoid evaluating the "bad" ideas?
- Did you observe other group members with this same problem?
- Did the leader make sure that everyone had an adequate opportunity to contribute ideas?
- Did the leader remember to include his own ideas?
- Was anyone made "fun of" for contributing a strange or foolish idea? How could this have been avoided? How could it have been handled differently?

Exercise 2[10]

Title: Behaviors in Groups

Purpose: This exercise is intended to sensitize people to the three basic categories of group behavior originally identified by Bales (1950). These three categories are task-oriented, social-oriented and self-oriented. Because the self-oriented behavior category is obviously undesirable, group members may not be expected to share publicly their observations of such behavior. One way around this is to ask everyone to submit a confidential report as an out-of-class assignment. Some observations can be directly shared in the small group setting. That is the focus of this exercise.

Time: Thirty minutes.

Group Size: Unlimited number of small groups of four to six persons each.

Materials: "Behaviors in Groups – Observation Summary Form"; pencils and paper.

Summary and Rationale: In this exercise students will observe a working group and try to identify behaviors that facilitate or hinder the group. This still is necessary if individuals are to be able to analyze the workings of groups of which they are members.

Procedure:

1) Form small groups randomly. Explain that each group will have a 10-minute discussion to prepare an answer to an assigned discussion question. (The questions can be on any topic, but it is usually interesting to devise questions about group behavior, such as "Do students need leadership skills?") If it has been decided that the groups will be ongoing teams working on a project, then the group's task is to decide what project to work on.

2) After 10 minutes, stop the discussions. Ask everyone to turn to the "Behaviors in Groups - Observation Summary Form" (Figure 7, Page 42). Everyone lists the group members (including themselves) in the left column and then privately fills out the form, using specific examples of behavior.

10 This exercise is adapted from *Organizational Behavior: Concepts and Experiences* by Marshall Saskin and William C. Morris, Reston Publishing, Reston, VA, 1984.

3) After 10 minutes, ask everyone to stop and to select an example of their own behavior that they identified. Group members now are to try to guess what behavior each other person picked as characteristic of him or herself. This can be done most easily by simply going around the circle, a person at a time. Everyone makes a guess, then when all have guessed, the person tells the group which behavior was really the one he or she picked. (If people are "uptight" about revealing how they saw others in the group, then everyone can write their guesses on a small slip of paper; all slips are mixed up and handed to the appropriate person, who then announces the "correct" behavior.)

Discussion Questions:

- Which category of behavior was most used in the actual group discussion?
- How accurately did group members perceive one another's behavior?
- When other members' perceptions of one person's behavior differed from that person's self-perception, who was really right?

Figure 7
Behaviors in Groups -- Observation Summary Form

Group Member	Behavior Directed Toward Task Accomplishment	Behaviors Directed Toward Social Interaction and Maintenance of Group Morale	Behaviors Directed Toward Purely Personal Needs (Not Related to Group Needs)

Exercise 3[11]

Title: Group Process Observation Analysis

Purpose:

1) To provide a framework for evaluating group effectiveness.

2) To stimulate discussion among group members on ways to change or improve group dynamics.

Time: Fifteen minutes to complete the evaluation; 30 minutes or more to share and discuss the ratings.

Materials: Observation Form.

Summary and Rationale: The purpose of this activity is to provide a framework for evaluating the effectiveness of a group. Students observe the behavior of a group working on a problem and then try to rate the group on a series of behavioral categories.

Procedure:

1) Form teams of five students.

2) Have students review the 11 different "Observational Categories" of group effectiveness in the questionnaire on Pages 45 and 46. Make sure they understand what each of these categories means. If they have questions, clarify the dimensions. Assign each team a problem to solve. For example "What can be done to get students to study harder for tests?" Then have students actually observe the "target group" as it works on a task or problem. Have them make notes about each category. It is extremely important to take as detailed notes as possible. They should be specific about what people actually did or said to confirm observations. They should avoid trying to interpret why people might have done those things, and avoid evaluating whether those things are good or bad, healthy or unhealthy, and so on. They should focus on making descriptive, detailed observations, rather than on making inferences or drawing conclusions.

11 Adapted from *Experience in Management and Organizational Behavior*, 2nd. ed., by D. T. Hall, D. D. Bowen, R. J. Lewicki, and F. S. Hall, New York, N.Y., Wiley, 1982.

3) Actual Group Observation – 5 minutes

4) Have members share their observations with their groups. When discussing Observational Categories, make sure that they report detailed, descriptive information for each of the categories. Have them give specific examples and behaviors to support the report.

Discussion Questions:

- On what dimension was the group that you observed or rated most effective and least effective? How would you account for this?
- Was there much variability among observers on any particular dimension? What does this tell you about group process?
- How did the group that was evaluated react to the feedback? Was this reaction due to the evidence being presented, or the way that the information was presented by observers?
- On what dimensions does the group need to improve the most?
- What specific changes in behavior would lead to greater effectiveness on particular dimensions?

Observational Categories

Criteria	Behaviors that I observed
Goals Stated? Clarified? Shared by all? Interest? Shared commitment?	
Problem Diagnosis Systematic diagnosis? Symptoms separated from causes? Jumping to solutions?	
Decisions Decisions made? Made by one or two members or whole group? Level of commitment to solution?	
Participation Who talks? How much? Participation by all or just a few? Who says least?	
Listening People attentive? A lot of competition for "airtime"? People often interrupted, cut off? People ask for clarification or pursue ideas systematically?	
Feelings Feelings expressed? Expression of feelings supported and encouraged? People considerate of others' feelings, empathy actively shown?	

Observational Categories

Criteria	Behaviors that I observed
Influence Who influences others most? Least? Why? How many people have influence? When? Influence related to the task of the group?	
Leadership Who is the "leader?" Appointed? Elected? "Self-chosen?" What does the leader do to control/manage the group? Does the leader overcontrol or undercontrol the group? How?	
Conflict Does conflict occur? When? Is conflict avoided, minimized or left? Is conflict openly expressed and left unresolved? How do people handle emotions (anger, difference of opinion, dislike)?	
Trust Do people trust each other? Are people overly polite or "careful" about what they say? Are people defensive? Is criticism of other people or ideas avoided?	
Creativity Are people disinterested in the group and its work? Are new ideas or approaches to problems encouraged and tried? Is there a fixed routine or pattern of work that seems to be inhibiting the group?	

Exercise 4

Title: Reaching Consensus

Purpose: The aim of this exercise is to illustrate the concept of consensus. (Consensus is general agreement within a group of decision makers. Consensus is not necessarily total agreement and not majority vote. Consensus is an agreement that all group members can "live with." That is, they can accept the intent and direction of the decision as a basis for further examination and discussion.

Time: One to one and one-half hours.

Materials: Chalkboards or flip charts.

Procedure:

1) Form groups of about six students.

2) Students read the case study that follows on page 48.

3) After reading the case study the students should agree on the core of the problem and reach consensus on the way(s) to remedy it.

4) Students in each group should keep notes on what each of them got and what they gave up to reach consensus on the problem solution.

5) The entire class should meet to discuss the concept of consensus versus majority rule or total agreement.

Situation Description

Mr. Warner is a demanding teacher, but he also is a very good teacher. Getting a good grade in his class is nearly a must in order to get a good job recommendation from the school.

Students in Mr. Warner's class — which has grown to be a two-semester course — have been questioning his grading practices. After a number of complaints from students, a school counselor looked over a short history of his grades. About 78% of the students in the last two years have gotten a 'C' or lower; about 83% of the girls received the same.

A formal complaint was filed with the principal by Mark Connors and his parents. They charged that Mr. Warner's grading was out of line with that of other teachers. They thought that Mr. Warner should bring his grading closer to that of other teachers in the school.

When asked by the principal about his grading of Mark, Mr. Warner said: "I teach a very important course in this program. It is my right to grade as I please as long as I am consistent and fair. Students who don't make it in my class probably shouldn't work in businesses and industry around here."

Mark commented: "I am a 'B'-average or better student. The scores that I received on Mr. Warner's tests would give me at least a 'B' in any other class. Most of the students in my class barely passed his midterms — lots failed. This is my last semester. I'm a good student, but something is wrong here."

The principal appoints you and your group to give him some ideas from the student viewpoint about what he might do. None of you is in Mr. Warner's class. the principal asks you to give him three pieces of information:

1. What is the core of the problem?

2. Who in the school should be involved in resolving the problem?

3. What should be done to try to reach a solution?

Your group should reach <u>total</u> agreement on the problem. It should reach <u>consensus</u> on points #2 and #3.

(**Remember**, your group is advisory only)

Exercise 5

Title: Group Decision Making

Purpose: The purpose of this exercise is to allow students the opportunity to make choices as a group. The exercise is structured in such a way as to bring the different values of students into the decision-making process.

Time: One hour.

Materials: None.

Procedure:

1) Form groups of about five students each.

2) Students should each read the case of the student council.

3) After reading the case on page 50, the group must decide on a solution to the situation. There should be no voting. Each member of the group must agree on the solution.

4) The entire class should come back together and discuss the interactions within groups.

Discussion Questions:

- What was the effect of people's individual values on the decision-making process?
- Are there some ways that value conflicts can be reduced in groups?
- Were there any "right" answers to the problem posed? How is this type of problem different from problems where there are right or best solutions?

Situation Description

Two weeks ago, the student council received notice that a rich member of the community had willed $10,000 to your high school. In order to qualify for the money, however, the following terms must be met:

1) The decision on how to spend the money must be made by students.

2) The student council should be the decision-making body for the students.

3) The decision must be made by March 15th.

4) The money can be spent on anything as long as it is the students who make the decision.

It is now March 14th, and the council members are meeting to make their decision. Before the meeting, notices had been sent out to teachers, students and administrators asking them for suggestions on how the money should be spent. The following 10 proposals were received for spending the money.

List of Proposals

1) Renovation of the gym including new student seating and an electronic timeclock.

2) Purchase of a new computer system to replace the paper card catalogue system in the school library.

3) Build a faculty lounge. The existing lounge is currently used for storage and extra office-space.

4) Replace the curtain in the student auditorium. The existing one does not operate and caused the cancellation of last year's student play.

5) Purchase new electronic diagnostic equipment for the student auto repair classes. They could also be used for the adult education classes in auto mechanics.

6) Remodel the student lounge area. The carpet in the existing lounge is worn and many of the chairs are torn or broken.

7) Help pay for the student marching band to go to the Rose Bowl Parade this year. The band has been invited, and it would be a great honor for them to be able to go and represent our school.

8) Set up a set of lectures by famous people to come and speak at assemblies. The money could be used to pay their fees and expenses.

9) Buy word processing software for the student computer lab and make it available for students to use to write papers for classes.

10) Have an all-school dance with a well-known rock band. The money could be used for the band, refreshments and decorations. Students would be admitted free.

Assume that your group is the school council. How would you spend the money?

Exercise 6

Title: Group Process Evaluation Exercise

Purpose: To insure that students have an understanding of group processes and how those processes affect group performance.

Time: One hour.

Materials: Paper and markers

Summary and Rationale: In this exercise, students are to design their own experiential activity intended to teach group processes to some other group. If students are able to put together an activity that incorporates the basics of the group process, then it indicates that they mastered the basics of the area.

Procedures:

1) Form teams of five students each.

2) Inform the teams that they are to construct an activity that will teach some important component of group process to a group of students like themselves. Each exercise that is developed must contain the following parts:

   a) Purpose

   b) Time

   c) Materials needed

   d) Summary and Rationale

   e) Specific Procedures

   Students should be given approximately 45 minutes to do this part of the activity.

3) Two or three teams can then be chosen to present to the class their specific exercises. The presentation should focus on how the activity actually incorporates some principle of the group process. The remainder of the class should be encouraged to critique the presentation and make suggestions for improvements.

Suggestions to instructor:

1) Encourage students to be creative. The more they build in movement and interaction the better.

2) The activities that are created can be used on the entire class. You can pick one of the activities that is especially effective and have the entire class do it.

Part 4 – Developing Additional Exercises

In developing an exercise, the following themes should be considered:

Justification: Virtually all people function in groups -- families, classrooms, churches, work, etc. Knowing how groups work enhances one's confidence and controls.

Information: Information comes from being able to classify what is happening in a group at any one time. This information is cognitive information. Essential other information comes from watching and noting the actions or behaviors of group members.

Motivation: Individuals who are successful in understanding group processes and their own roles in groups are more likely to gain satisfaction and achievement in them.

Expected Outcomes: Knowledge and skill about group processes are the desired outcomes of the exercises. These factors enhance the likelihood of achieving group goals.

Some suggestions for activites to emphasize points above:

- Analyze and compare the structure and processes in different kinds of groups -- school, social club, family, work, etc.
- Classify and record behaviors in a public meeting.
- Analyze rewards and punishments that operate in different groups. How do people achieve in different groups?

Examine group members' actions to try to reach group goals.

Part 5 – References on Group Processes

"A Partnership to Build a New Work," *Business Week*, June 30, 1980, pp. 61-64.

Bales, R. F., *Interaction Process Analysis: A Method for the Study of Small Groups*, Cambridge, MA: Addison Wesley, 1950.

Bennis, Warren G. and Shepard, Herbert A., *A Theory of Group Development, Human Relocations*, Summer 1963, pp. 415-457.

Crocker, O.L., Charney, S. and Chiu, J., *Quality Circles: A Guide to Participation and Productivity*, New York, NY: Mentor, 1984.

Jones and Pfieffer., *The Annual Handbooks for Group Facilitators, 1971-1989*, San Diego, CA: University Associates.

Saskin, M. and Morris, W. C., *Organizational Behavior: Concepts and Experiences*, Reston, VA: Reston Publishing, 1984.

"The Worker Knows Best," *Time*, Jan. 28, 1980, p. 65.

Unit III: Communications

Rationale: Without the ability to move information in a clear and efficient manner, individuals and organizations cannot function well. Good communication is not always common sense, and the skills to be a good communicator must be learned.

Objectives: To inform the students about the elements of good communication. Students should also be able to recognize situations where there are problems with the communication process.

Student Learning: The student should be able to diagnose problems both in written and verbal communication. He or she should also be able to examine the setting in which communication takes place and be able to analyze his or her own skills with respect to interpersonal communication. For each of these areas the student should be able to make suggestions for improvements when problems occur.

Contents of this Section:

1) Need statement

2) Lecture material

3) Exercises

4) References

Part 1 – Need for Good Communication

Communication is the glue that holds the process of cooperation together. Bringing people together in a group does not guarantee that they will interact in effective ways. Similarly, a well functioning group may not be as effective as it could be if it is unable to communicate with its outside audiences.

Certainly, this topic is not limited in importance to business or school settings. However, communication skills are critical if these organizations expect to maximize the potential of their people. Teachers and managers both play a key role in fostering good communications within the groups over which they have influence. These leaders create the climate that controls the type and effectiveness of communications. Additionally, they serve as role models for others on the team.

Individual members of work teams also need to possess effective communication skills. A person with good ideas who is unable to express them will not contribute to a team effort. The other side of this coin is the problem created by the group that does not know how to process good ideas generated by its individual members. In order to be effective, the process of communication must be learned along with the potential problems that can reduce the effectiveness of communications.

There is a set of skills that can be learned and practiced by individuals to improve their ability to communicate. These interpersonal communication skills are generally not well used by most people in everyday life. This "malpractice" of communication skills leads to unnecessary misunderstanding and conflict. Most teachers can identify at least one instance in their experience when a seemingly simple assignment was misunderstood by students and led to more work for everyone in the long run.

The same kinds of problems can and do occur between teachers and administrators. What was thought to be a simple procedural change by a department head turns into a major source of conflict with the faculty. The misunderstanding can often be the result of something as simple as not getting feedback or misinterpreting casual responses or body language.

This unit will attempt to identify the elements of the communication process as well as provide an opportunity to practice them.

Part 2 – Background for the Study of Communication

The communication process can be studied at two levels. The first of these levels is the organizational level. Here we examine what the organization can do to have an open environment that fosters effective communication. Below is a comparison of behavioral characteristics distinguishing effective and ineffective organization climates.

Table 5
Categories of Behavior Characteristics of Supportive and Defensive Communication Climate

Defensive Climate	Supportive Climate
Evaluation	Description
Control	Problem orientation
Strategy	Spontaneity
Neutrality	Empathy
Superiority	Equality
Certainty	Provisionalism

These climates are established by the top leaders and generally filter throughout the entire organization.

It is also important to be aware of the components of the process of communication. Each of the components represents a dynamic interaction. To the extent any of these elements is ignored, problems can be introduced into the process. The figure below shows the elements in the process.

Figure 8
Model of Communications

Source-----> of message	Encoder----> of message	Message---->	Channel------>	Decoder-------> of message	Receiver of message
Ideas					Ideas
Needs	Motor skills	Code		Motor skills	Needs
Intentions	Muscle system	Set of symbols	Medium Carrier	Muscle system	Intentions
Informa-tion	Sensory skills			Sensory skills	Information
Purpose					Purpose

The model in Figure 8 shows that the process of communication depends on many factors for success. For each element, there are a number of individual points to consider. If the first element is examined, for example, it can be seen that the source of a communication is a combination of content (ideas, information) and personal characteristics of the message sender (needs, intentions and purpose).

The element called "encoder" can be examined in the same way. In order for a person to actually prepare a message to be sent, he or she must use certain physical capabilities such as motor skills, muscles and senses.

Let's look at this model in a couple of life-like situations. First, a man decides to call his older sister on her birthday. He picks up the phone and dials her number. He is the source of the message -- that is, his decision, intentions, needs and information are the source of his actions. In this example, he is also the encoder; he must do something with his mental processes to get out the message he wants. He must use the phone, say words, etc. His message is verbal and spoken; he could have sent a card -- verbal and written. The channel, in this case, is electronic: mediated by the telephone system. When the sister answers the phone, she must gather the message through her ear and auditory processes. She is the decoder and the receiver. When she hears, "Happy Birthday, Sis. Remember, I'll always be younger than you!," she will process the decoded message based on her ideas, needs, past experience with her brother and so on.

Second, a principal of a school comes back to her school after a mid-morning meeting with the school board. She is annoyed about the way the meeting went. Her parking space is filled; she has to drive to the back of the parking lot and walk through a drizzle of rain. This is it! She calls her secretary on the intercom and says curtly, "Ellen! I want you to get the word out to the staff right now. Tell them to park where they're supposed to park, or we're going to have to have a meeting to go over school procedures and policies!" The secretary has never heard the principal so annoyed.

Within half an hour, a typed memo is in every teacher's mailbox and is posted on the main bulletin board by the office, in the teacher's lounge, in the cafeteria and in the maintenance room. The memo states:

"There will be a mandatory meeting of all teachers and staff tomorrow, March 3, in the cafeteria at 3:30 p.m. We will go over the school policy manual and discuss our parking problem."

Some reactions of those who read the memo:

Teacher: "Man, do I agree. I've had to park on the street a couple of times last week!"

Cook: "I'm here before anyone else. I leave by 1:30. I'm not staying two hours for some meeting that doesn't have anything to do with me."

Teacher: "What's this? I don't get here until 6:00 for night classes! What's the problem anyway -- there's all kinds of parking."

Assistant Principal: "It's about time we got to this problem."

Teacher: "Boring! The manual again."

Custodian: "I don't get here 'til everybody leaves. Three in the afternoon! What a hassle."

Teacher: "Hmm. That was yesterday. Sure save time teaching night class on Tuesday and Thursday."

Principal: "This isn't what I really had in mind, but Ellen has sent it out."

Applying the communication model given before, it is clear that the principal is the source of the message. She had to do some encoding -- that is, changing her emotional upset and intentions into a message to the secretary -- but she gave the "formal" encoding responsibility to her secretary. The secretary took the emotions and words that she thought that she heard and formed them into the actual message. She chose to use a memo and posting or mailboxes as the channel for the message delivery.

When the receivers, and also decoders, of the message read the memo the message that they perceived was filtered through their own emotions, knowledge, purposes, etc.

At each stage of this process, failure may occur. The principal did not get out to her staff and teachers what she wanted to say at the time. Failures in this model process are called "noise." The more noise that enters a line of communication, the less likely the original intended message has of getting to the receiver. Picture an administrator telling a secretary to call another secretary to give a message to another person. The chances of the original, intended messages getting through get less and less.

The choice of channel is critical. Suppose that a person thinks through problems and issues very well; the person also speaks well, but does not write well. If this person is pressed to write his or her ideas vs. talk about them, the channel is not favorable to him or her. Examples could go on and on. In the case of the principal above, the elected channel received mixed reactions. It was not what the principal intended; it did not pertain to some people and was received too late by at least one person.

The model has shown only one part of the communication process. Once a message has been received, another usually is returned. Hence, the first receiver becomes the next sender. The process becomes more and more open to noise.

The key to understanding the complete model lies in the realization that good communication is a dynamic interactive process, not a linear step by step one. This means each part is affected by the others and no single element can be viewed as independent. For example, if two

people are engaged in a conversation, the reactions of the listener have an effect on the speaker's needs, choice of code (words) intentions, etc. Good communication requires that people be aware of the parts of such a model and makes sure that there is as little noise affecting each part as possible.

Some of the more common problems (noise) that occur in organizational communication systems are:

1) Filtering

2) Jargon

3) Lack of common experience

4) Semantics

5) Selective attention

6) Value judgments

7) Lack of source credibility

8) Overload

9) Omission of feedback

These problems can occur both at work and in the classroom. They arise from failure to pay attention to the communication process itself. For example, "experts" often forget that students or subordinate workers may not understand particular terms (jargon) quite familiar to the expert. The receiver's need to maintain self-esteem may prevent that person from asking for a clarification. In this situation, the process can break down in two places both with the sender and with the receiver.

Interpersonal Communication

In addition to the organizational level, it is important to study the communications process at the interpersonal level. Here, of course, concern focuses upon how individuals process information between or among individuals. The type of communication used is generally verbal but, of course, can be written. Interpersonal, face-to-face communication also carries with it many strong non-verbal cues.

In order to be an effective communicator, an individual needs to develop skills which will facilitate the process. Below is a list of the skills are needed for effective interpersonal communications.

Table 6
Communication Skills: Summary

Attending	Open relaxed posture; lean foreward Frequent eye contact Occasional verbal and gestural encouragement to talk: nodding, smiling, etc.
Listening	Repeating for clarification and improved accuracy Rephrasing (paraphrasing) to show accurate understanding of content Active listening to show understanding (not agreement or sympathy) of feelings as well as content
Questioning	Posing questions to achieve appropriate levels of openness or confidence Probing through appropriate use of silences (pauses), nonverbal indications (expressions, gestures), and brief open questions "Can you tell me more?," "Anything else?," "Then what?"
Feedback	Descriptive, nonjudgmental Concrete, with specific detail Desired (or, at least, with "warning" ahead of time, not "dumped") Tuned to the needs of the receiver, not just those of the sender Timely (not "stored up" and dumped) Useful, dealing with things the receiver can do something about
Summarizing	Concise restatement

Nonverbal Communication

Nonverbal communication includes all the human and environmental elements associated with human communication that are not expressed verbally. The human elements include facial expressions and physical movements; these may be habitual or consciously or subconsciously performed. Facial expressions have been studied and categorized as:

1) Interest-excitement
2) Enjoyment-joy
3) Surprise-startle
4) Distress-anguish
5) Fear-terror
6) Shame-humiliation
7) Contempt-disgust
8) Anger-rage

The eyes are the most expressive component of the facial display. Physical movements, or "body language," can also convey a great deal of meaning. (This category includes both actual movement and body positions during communication.) The handshake is probably the most common form of body language. Other examples are tilting of the head, sitting on the edge of a chair, and folding the arms. Probably the most important issue here is that people often do not pay enough attention to their own nonverbal cues. The result is that we often give unintended messages without being aware of having done so.

Feedback

Feedback is a critical element in the interpersonal communication process. Below is a list of guidelines to be used when giving feedback in an interpersonal situation:

Feedback Guidelines:

1) It is descriptive rather than evaluative. By describing one's own reaction, it leaves persons free to use it or not to use it. By avoiding evaluative language it reduces the need for individuals to react defensively.

2) It is specific rather than general. To be told you are "domineering," will not be as useful as to be told that "just now when we were deciding, you did not listen to what we said and I felt forced to accept your arguments or face attack."

3) It takes into account the needs of both receiver and giver of feedback. Feedback can be destructive when it serves only our own needs and not those of the person receiving it. Feedback is most useful when the receiver has asked for it.

4) It is well timed. In general, feedback is most useful at the earliest opportunity after the given behavior (depending of course, on the person's readiness to hear it, support available from others, etc.).

5) It is checked and sorted out by the receiver.

Feedback following these guidelines will help both parties in an interaction and make sure that messages are being properly received and sent.

It should be realized that these principles are often difficult to apply especially under stressful interpersonal situations. Practice however will insure that they are used correctly.

Asking Questions

Questions are essential parts of all languages. Basically, they are used to get information. In everyday life, we tend to ask questions sloppily. People, in return, tend to answer questions in the same way without regard to what actually was asked. For example:

Visitor: "Can you tell me where the airport is in Kokomo?" (Wants to know directions.)

Other person: "Sure. Stay on this highway for about nine or ten stoplights. You'll start seeing signs to the airport. It's on the east side of town." (Assumes the inquirer wants to know directions.)

Neither person in this exchange was exact. The questioner should have asked, "Where is the airport in Kokomo?" The other person answered as if that were the question. According to the question asked, he should have ended his answer with, "Sure." Comedians have made good use of this same situation and our usual inexact questioning and answering. A man in a panic -- being chased -- stops a passerby:

Man: "Can you tell me where the Grand Hotel is?"
Passerby: "Yes." (Continues walking away.)

We do not have to ask questions precisely most of the time. But under some circumstances, questions or other statements requiring responses and answers must be carefully formed in order to gather and shape sound information. Below are several situations requiring careful questioning to get the best information available:

Evaluation: Teacher determining what the students know; licensing agent determining the qualifications of an applicant.

Diagnosis: Mechanic trying to find out what a customer thinks is wrong with a car; physician determining the cause of a patient's complaint.

Investigation: Policeman trying to find the cause of an accident; lawyer and judge getting valid testimony from a witness.

For practical purposes, questions can be put into two major sets. One is a form of question that calls for simple, one-word answers. These are called "closed-ended leads." For example:

Do you know how to program this computer?
What year were you born?
Does the heating element get warm when you flip the switch?

The second form of question invites long, extended answers. These are called "open-ended leads." Examples are:

Why is water condensing on this pipe here , but not there?
What do you think we should do differently?
How do you handle a complaining, angry customer?

The two types of questions have two distinct purposes. The closed-ended lead pinpoints specific information; the open-ended lead invites broad description or explanation. (A person may not give a lot of information following an open-ended lead, but the inquirer has given him the opportunity to do so.)

These two forms of questions or leads appear in most teachers' classroom tests. Multiple choice, true-false and short-answer fill-in questions are closed leads. Essay questions are open leads.

The most thorough line of questioning uses both types of leads. In a courtroom, for example:

Tell us what you were doing on the evening in question? (Open)
Why were you there? (Open)
Did you see Mrs. Jackson there? (Closed)
Could she have come and gone without your seeing her? (Closed)

Or in a classroom:

Which of these two graphics is more interesting to the eye? (Closed)
Why? (Open)
What principle did the artist use? (Closed)
How could you use that principle in the assignment I just gave you? (Open)

Conclusion:

It can be seen that there are a number of things to consider regarding the topic of communications. One must first be concerned with how the organization itself deals with this issue. The organization cannot expect individuals to be good at communications if the climate that is set is not right. Next, people must know what good communication is all about. The elements of the communication process must be known.

Finally, individuals must know and practice the skills needed to be good communicators. This includes such things as listening and feedback skills, as well as nonverbal behavior.

Part 3 – Exercises

Exercise 1

Title: Closed-Ended Leads

Purpose: This exercise will show the participants how closed-ended leads work in the communication process. They will be able to see the limitations of using this form of question alone to get information.

Time: 30 to 40 minutes.

Materials: Pencils or pens and paper. A picture or sketch of a common object familiar to the students in their classroom, lab or workshop.

Procedure:

1) Choose one student from the group to be "Answerer." Inform the student that you are going to give him or her a picture, but he or she is not to tell the others what it is until they ask questions about it. The "Answerer" is, however, to tell the students that he or she is going to describe a place on a map, a picture of a common item in the classroom, an arrangement of objects, etc.

2) Tell the class members that they may only ask questions that can be answered by, "Yes," "No" or "Maybe." They are to try to draw what they think the picture is by getting information from the "Answerer."

3) Remind the "Answerer" to answer only with a simple "Yes," "No," etc.

4) Your role is referee. Be sure that only closed-ended leads are asked and answered.

5) Should the object in the picture be identified, have students keep on questioning so that they can draw the object on their papers as similar as possible to the picture held by the "Answerer." For example, if the object were a carpenter's hammer, how is it situated in the picture? Is the striking surface facing left, right, up, down? And so forth.

6) After 15 minutes or when the group is getting restless and questions are slowing down, have the students show what they have sketched -- if anything. Show them the picture.

7) Open a discussion on the exercise. Some points to cover are:

- What kind of information does this type of question or lead produce? (It produces very small amounts of very specific information.)

- What is the best use of these questions? (To confirm ideas from the answerer -- "Should we leave in the morning or afternoon? -- or the inquirer -- "This goes on the left, doesn't it?")

- What are major problems with this line of questions used alone? (The major problem is that closed-ended leads continue to keep the ball in the inquirer's side of the court; the one asking the questions must keep the conversation going. Job interviews and first dates can get off to a deadly start with closed-ended leads being used predominantly. They are the easiest form of question to ask, but they can get us into trouble, if used too much.

For the one answering closed-ended leads, the situation can also be frustrating; he or she may want to say more, but has not been invited to. The less two people know each other or if there is a superior-subordinate relationship, the pressure on the answerer is greater and the person may feel defensive. "Did you leave this mess?" "Yes, sir -- but I was . . ." "Have you looked for a job with anyone else?" "No. But you see, I just moved here and I haven't . . ." In these examples, the respondent feels pressure to explain in the form of an excuse. The one answering such questions may be caught with no satisfactory options: "Have you stopped beating your wife?"

Variations of Materials:

For additional exercises, use any of the following suggestions. Or create your own exercise(s) that may help emphasize other teaching objectives.

1) Provide the "Answerer" with a map of the city, state, world, etc. Select a location and permit the students to try to locate a site. Follow all of the preceding procedural guidelines.

2) Arrange on a table or desk top squares of paper or blocks of wood, etc., the arrangement of which can be described by the "Answerer" to the students.

3) Lay out a display of tools, office materials, etc., to be described by the "Answerer."

Exercise 2

Title: Open-Ended Leads

Purpose: The students will be able to recognize how open-ended leads affect the communication process. They will see the limitations of this form of questioning when used alone.

Time: 30 to 40 minutes.

Materials: Pencils or pens and paper. Obtain or sketch a picture of something that is highly unusual and probably not easily recognizable to the students. Choose an abstract drawing or painting -- or a set of doodles. Choose something like an amoeba that has an irregular, flowing shape.

Procedure:

1) Select one student from the class to be the "Answerer." Give the picture to the student. Tell him or her not to show or reveal the picture, but to answer questions about it. The "Answerer" may not respond to closed-ended leads -- "Yes-No" types of questions. He or she may only answer questions that invite explanation. Often these will start with, "How," "What," "Describe," etc.

2) Inform the other class members that they are to draw what they think the picture is. They are to try to find out by asking open-ended questions that will permit or give the "Answerer" the opportunity to describe the picture. (NOTE: It is important, therefore, that the picture be very complicated or very unusual.)

3) Your role is referee. Permit only open-ended leads to be made and answered. (NOTE: You will have to be watchful, because closed leads are so easy to ask. They slip in unconsciously.)

4) Should the picture become identified, have the students strive to make their drawings as much as possible like the original.

5) After 15 minutes or so, judging by the group's response, ask the students to draw what they think the picture is -- or finish their drawings. Ask them to show them to the class. Show them the original picture.

6) Open a discussion about the use of open-ended leads or questions as a main line of questioning. Some issues to address are:

- What kinds of information do open-ended leads produce? (These leads invite the giving of lots of descriptive material, opinions and explanations.)

- What is the best use of this question type? (Such questions open the chance for the inquirer to learn about what the answerer knows or thinks about some topic. "What do you think about . . .?" "How did you get that finish so clear?" "Where is this going, if we don't do something soon?"

- What are the major drawbacks with this method of questioning used by itself? (The one asking the question cannot control the answer. The one answering can go off in all directions; he or she cannot be pinned down to clarify a point or derive a simple, concise conclusion.

- Compare the styles of information obtained in Exercise 1 and 2. Which enabled the students to understand the "Answerer's" picture better -- or did either?

Variations of Materials:

For additional exercises, use any of the following suggestions. Or create your own exercise(s) that may help emphasize other teaching objectives.

1) Provide the "Answerer" with a map of the city, state, world, etc. Select a location and permit the students to try to locate the site. (Use the "Procedures" on the preceding page.)

2) Arrange on a table or desk top squares of paper or blocks of wood, etc., the arrangement of which can be described by the "Answerer" to the students.

3) Lay out a display of tools, office materials, etc., to be described by the "Answerer."

Exercise 3 (Optional)

Follow the same format as above. Select a complicated, but reasonable, picture. Permit both open and closed-ended leads to be given.

Assess students' drawings on the quality of similarity to the picture that you chose.

Discuss the comparisons among the three approaches to questioning.

Exercise 4

Title: Communication Model – One Way

Purpose: This exercise is designed to help participants understand the communication model proposed previously. Understanding will come from dissecting a communication path from sender to receiver. (See Figure 8, Page 58.)

Time: 45 minutes.

Materials: Paper and pencils or pens. Choose an example of one-way communication, e.g., a radio or television report; an article from a newspaper; a lecture; a letter, memo or directive. The necessary element in the example is that the one receiving the message cannot readily send back another message to the original sender. Also, the more controversial or slanted the content of the message, the more likely that noise will develop on the part of the receiver of the message.

Procedure:

1) Distribute communication examples to the students. Provide them with a copy of the communication model.

2) Instruct each student to apply the communication model to the example given.

3) Form small groups of three or four students.

4) Permit the groups time to compare and discuss the analyses that each student prepared.

5) Open a classroom discussion about the analyses that came about. Be certain to emphasize the interpretations and questions that the receivers experienced which cannot be resolved, because they have no means asking for clarifications in the one-way communication process.

Discussion Questions:

- How well does the communication model help to understand problems and successes in the communication process?
- What problems come about for the receiver in the one-way communication process?
- What problems come about for the sender in the one-way communication process?
- Who is responsible for the accuracy of a communication?

Exercise 5

Title: Communication Model -- Two Way

Purpose: This exercise is designed to help participants understand the communication model proposed previously concerning two-way interactions. (This exercise should follow Exercise 4, One-Way Communication.)

Time: 45 minutes.

Materials: Paper and pencils or pens. Choose an example of two-way communication, e.g., a question-and-answer session from a classroom or lecture; a debate; Letters to the Editor (compared to the original newspaper article); the tape of a conversation, etc. The key element in the example is that messages be exchanged between two or more people. The more controversy or bias in the messages, the more likely that noise will develop between the senders and the receivers.

The communication model used before must be modified slightly. The original (Figure 8, page 58) was of a one-way communication. Simply reverse it after the first message and the first receiver becomes the next sender.

Procedure:

Use the procedures from Exercise 4.

Discussion Questions:

- How well does the communication model help to understand problems and successes in the communication process?
- What problems come about for the receivers in the two-way communication process?
- What problems come about for the senders in the two-way communication process?
- Who is responsible for the accuracy of a communication?

Exercise 6[12]

Title: Nonverbal Communication

Purpose: The purpose of this exercise is, first, to illustrate common non-verbal "signals" and, second, to explore the "potency" or power of non-verbal communication as compared to verbal communication. Most non-verbal communication deals with feelings and, hidden though they may be, feelings are typically far more potent than the "rational" parts of messages.

Time: 30 to 45 minutes.

Materials: Paper and pencils.

Summary and Rationale: In this exercise students get an opportunity to actually use non-verbal cues to communicate. In this setting they have an opportunity to see how powerful non-verbal cues can be without experiencing any potential negative consequences.

Procedure:

1) Ask everyone to write down three feelings (such as "happy," "irritated," etc.).

2) Form small groups.

3) Each small group member will try to communicate non-verbally one of the feelings he or she wrote down, without showing anyone which one is on the paper. After a minute or so of trying, the other group members guess at the feeling. The person then tells them what the feeling really was, and records how many were correct. Each small group member takes a turn at this, with a new feeling.

4) The entire class then reviews the overall level of accuracy and briefly discusses the typical accuracy of non-verbal communication.

5) In the small groups, again, step three is repeated except that while the person is giving the non-verbal message, he or she also gives a different verbal message. (The verbal message need not be opposite to the nonverbal, but must be different.)

6) The entire class group discusses the difference between the two non-verbal communication approaches.

12 Adapted from Saskin & Morris

Discussion Questions:

- How accurately were people able to understand the first round of non-verbal signals? Were more subtle or less common feelings harder to identify?

- What happened to the level of accuracy when a different verbal signal was present? Where does this sort of "semantic noise" fit in the communication model shown in Figure 8 (page 58)?

- When you see this happen in a real situation -- different verbal and non-verbal messages are sent -- which are you most likely to believe? Why?

Exercise 7[13]

Title: Active Listening – Written Confirmation

Purpose: This exercise gives practice in making reflective responses. By using written, rather than verbal responses, participants can go slowly and can revise their attempts more easily. It is important to take the statements one at a time, so that class members can apply their developing skills to succeeding statements.

Time: 30 minutes.

Materials: Pencils and paper.

Procedure:

1) Explain that all the statements on the "Active Listening" response form on page 77 are comments made by an employee to his or her boss. Everyone is to write a brief response, pretending to be the boss speaking to the employee. The response must identify the feeling the employee seems to be experiencing or expressing, as well as a restatement, in different words, of what the employee said. Be sure to explain that the response is not to include any justification or explanation, just a restatement of what the employee said and appears to be feeling.

For example:

> Employee: "I know that personal phone calls aren't allowed, and I'm sorry. But I was really worried about my mother. She got very sick over the weekend."
>
> Boss's assessment of employee's feelings: Embarrassed about breaking rules; upset about mother. (Concern for the mother, obviously came before following shop rules.)
>
> Boss's restatement showing that he heard his employee: "I can see that you're concerned about your mother and you decided, then, to call to see how she was -- even if you broke shop rules."

2) Ask everyone to write a response to the first item only. Allow about three minutes. Then ask for volunteers to read their responses. Call on a few other class members. Discuss briefly which responses best meet the requirements in Step One.

13 Adapted from Saskin & Morris

3) Repeat Step Two for each of the 10 statements. By the 10th statement, everyone should be writing accurate responses with little difficulty.

Discussion Questions:

- Are some feelings harder to identify than others? Why? Are some harder to reflect? Why?
- What would happen if the feeling was incorrectly identified?
- Could a conversation be based on active listening responses? Do you think this would be difficult or easy?

ACTIVE LISTENING

Statement	Feeling	Response
1. Mr. Jones is really getting to me because of the way he insists on doing the project *his* way.		
2. I'll either do it or have it done on time -- you can count on it!		
3. If you didn't keep giving us these unexpected rush jobs, there wouldn't be so many errors!		
4. I really thought the report was so good it would get my teacher's praise. Now, it seems that he just doesn't care.		
5. Why don't you get off my back!		
6. What's this about me being scheduled for overtime on Saturday? I worked *last* Saturday, and it's not my turn this week!		
7. I studied over your procedural proposal. We tried a procedure like that two years ago; it didn't work then, and I don't know why it would now.		
8. I can think of better ways to spend my time than in these pointless, endless meetings.		
9. Can you tell me about this appraisal session coming up? Will all the problems of the past year be reviewed?		
10. You shouldn't bawl me out in front of everyone! What will they think?		

Exercise 8[14]

Title: Communicating Spoken Instructions

Purpose: Students will practice giving and receiving spoken instructions and will appreciate the importance of giving and receiving instructions effectively in work situations.

In almost every work situation, directions or instructions for completing a task are given by one person to another. A supervisor gives instructions to employees, and employees may give instructions to each other. Instructions must be clear, concise and complete in order to be understood. The person giving the instructions must be sure that the person receiving the instructions has understood. Giving and receiving verbal instructions is a skill used daily by most workers. Students need to practice this skill.

Materials: Pick-Up Truck Instructions (page 81), Supply Room Instructions (page 82).

Procedure: Giving and Receiving Instructions.

1) Tell students that in this activity they will use their skills in a) listening to job instructions and b) communicating job instructions correctly to someone else.

2) Explain that a team of five students will leave the main classroom. As they are brought back into the room, one at a time, they will be given a set of instructions.

3) Explain that you will read the instructions aloud to the first team member coming back into the room. This first member will try to remember the instructions so that he or she can communicate these instructions to the next student coming into the main classroom.

4) In turn, each of the five team members will hear the instructions and then attempt to repeat them to the next member. This procedure will be repeated until all five students have participated. The fifth team member will repeat the instructions to the entire class.

5) The person receiving the instructions may not ask questions. The person giving the instructions may not repeat the instructions.

6) Distribute Pick-Up Truck Instructions. Students not participating in the passing of information will listen as each person repeats the instructions, noting any mistakes.

14 Adapted from *The Methods and Materials for Teaching Occupational Survival Skills*, R. E. Nelson, N. A. Flexman, J. A. Leach, and T.J. Scanlan, Illinois State Board of Education, 1978. Used with permission.

Follow Up:

1) After the activity is completed, have the students use their worksheets to answer the following questions:

   - How did the instructions change as they were passed from person to person? What was added or left out?

   - What effect could mistakes in the instructions have on the way the job is done?

   - (To team members): How could you improve the giving and receiving of instructions? Examples:
     - Asking questions
     - repeating the instructions
     - writing the instructions down

   - (To team members): Do you think that asking questions and repeating the instructions would improve accuracy? Why or why not?

2) Select another team of five class members and repeat the procedure using the Supply Room Instructions. This time, allow team members to ask questions, repeat instructions, or take notes.

3) Students not participating in the passing of information will note mistakes on the Worksheet in Column A as before. In addition, have them note in Column B how each team member made sure he or she understood the instructions.

4) After the second team has completed the exercise, conduct a group discussion of the following questions:

   - Was the second team more accurate than the first team? Why?

   - (To team members): Did asking questions help you to understand the instructions? Why?

   - (To team members): Did it help you to repeat the instructions? Why?

   - What are the hazards of giving spoken instructions?

   - How can these hazards be avoided? Examples:
     - take written notes
     - ask questions
     - repeat instructions
     - pay close attention

- How can we improve our skills in giving spoken instructions? Examples:
  - state instructions simply
  - ask if there are any questions
  - state instructions slowly

- List additional ways of making sure we give and receive instructions correctly. Examples:
  - Assign numbers or steps to each part of the instructions
  - When giving instructions, tell the reason for doing a task
  - Don't trust your memory. You may be given additional information, which may confuse you or cause you to forget.

Pick-Up Truck Instructions

Ask Jim Richards for the key to the blue pick-up truck. Drive the truck to the automotive shop in Building B. Tell the mechanic to change the right front tire. Ask the mechanic to leave the ignition key under the left sun visor. Tell Rupert to go to the shop tomorrow morning and drive the truck back here.

Team Members	Mistakes
#1	
#2	
#3	
#4	
#5	

Supply Room Truck Instructions

Go to the supply room at the west end of the ground floor of the building. Ask for three small packages for Linda Ames. The clerk will give you two copies of the invoice. Check the invoice with the clerk. Sign the white copy and deliver the three packages and the yellow copy to Linda Ames in the Accounting Office.

Team Members	Mistakes (Column A)	How did the person make sure he/she understood the instructions? (Column B)
#1		
#2		
#3		
#4		
#5		

Exercise 9[15]

Title: Two-Way Process

Purpose: Students will become aware of a) the three elements of communications and b) the importance of two-way communication in job situations. Communications involves a sender, a message and a receiver. If any one of these parts is missing, communication breaks down. In a work situation, workers send and receive spoken messages. In this session, students will explore how the sender and receiver can affect the way a message is understood, and, therefore, the way a task is done. Students will also discover ways they can become more effective senders and receivers of messages.

Materials: Transparency #1 – Elements of Communication. Transparency #2 – Two-Way Communication Sheet. Two matched sets of various blocks (building blocks, Lincoln Logs, Tinker Toys, etc.). Each set should have between 20 and 30 pieces of various sizes, shapes, and colors. A screen or visual barrier, such as a large poster board. Overhead projector.

Procedure: Defining Communication

1) Have students write their definitions of the term "communication" on a sheet of paper.

2) Ask several students to read their definitions to the class.

3) Have the class agree on one definition by combining the various definitions, and write this composite definition on the chalkboard. For example:

   One definition of communication might be "an exchange of thoughts, opinions, or information."

4) Ask students to list the ways communication is accomplished on the job. Some examples of ways people communicate on the job are:

   - Talking and listening (spoken communication). For example, giving and receiving spoken instructions for a job to be completed would be spoken communication.

   - Writing and reading (written communication). Instructions and other messages are often communicated through office memos, letter, bulletin boards and employee handbooks.

   - Gesturing or showing expressions through motions of the body (non-verbal communication). A pat on the back for a job well done or a frown from across the table during a meeting are both examples.

15 Adapted from *The Methods and Materials for Teaching Occupational Survival Skills*, R.E. Nelson, N. A. Flexman, J.A. Leach, and T.J. Scanlan, Illinois State Board of Education, 1978. Used with permission.

5) Project Transparency #1 – Elements of Communication on the overhead projector to illustrate the three elements of communication:

- the SENDER (the person giving the message)
- the MESSAGE (the information being communicated)
- the RECEIVER (the person who is meant to receive the message)

Activity: Communication Blocks[16]

1) This activity demonstrates the importance of listening and asking questions when receiving communication.

2) Ask for two volunteers to participate in a demonstration for the class.

- Have the volunteers sit facing the rest of the class with a set of blocks in front of each person.
- Assign one volunteer to be the SENDER and the other to be the RECEIVER.
- Place a screen or visual barrier between the participants so they cannot see each other's work, or have them sit back to back.

3) The SENDER now arranges the pieces in any way, using all pieces, and telling the RECEIVER how to arrange his or her pieces in the same way.

The SENDER gives directions as each piece is put into place

4) The SENDER may say as much as desired in describing each piece. The SENDER may, for example, give the location and position of each piece. The RECEIVER must remain silent, ask no questions, and give no signs regarding the instructions. The RECEIVER simply does exactly what he or she is told.

5) The class members can see both arrangements as they develop. Naturally, they may react in various ways, even though they may be reminded to say nothing to help the participants. The SENDER may pick up these cues (sighs, laughs, chuckles, etc.) and become more careful about giving directions as the activity continues.

6) After all pieces have been placed, have the two volunteers compare their arrangements. Because there are likely to be many small (sometimes large!) differences between the arrangements, this usually leads to a lively discussion of why the "communication"

16 Reprinted with permission of Martin H. Crowe. Reproduced from *Activities and Exercises for Affective Education*. Kent D. Beeler and Lou Thayer, co-editors, AERO-SIG Affective Aspects of Education, 1975.

did not produce the desired results. The following questions may be asked to guide the discussion:

- Why are the two arrangements different?
- Did the directions seem clear to the SENDER? To the RECEIVER? To the class members? If so, how? Did this communication have any effect on the SENDER and RECEIVER?
- What might happen in a work situation in which "communication" occurs only in one direction?
- What is the worker's responsiblity when receiving instructions or other communication?

7) The same procedure is repeated with other volunteers from the class with one difference. For the second round, the RECEIVER may ask any questions necessary to clarify the instructions.

Follow-Up:

1) Using Transparency #2 – Two-Way Communication, explain how communication took place between the sender and the receiver in each round of the Communication Blocks activity.
   - The first round allowed information to pass only one direction: from the SENDER to the RECEIVER.
   - The second round allowed information to pass in both directions: the RECEIVER was allowed to ask any questions necessary to clarify the instructions. In most cases, the exercise is completed more accurately and efficiently when two-way communication occurs.
2) To summarize the activity, the instructor may wish to use the following questions for discussion:
   - Why were directions misinterpreted during the first round?
   - What differences were there when the RECEIVER was allowed to ask questions?
   - How did the RECEIVER'S questions help the SENDER to give clearer directions?
   - In work situations, who is responsible for communicating effectively?
   - In work situations, how can people who give directions make sure their directions are understood?

- In work situations, how can people who receive directions make sure they have undertstood correctly?

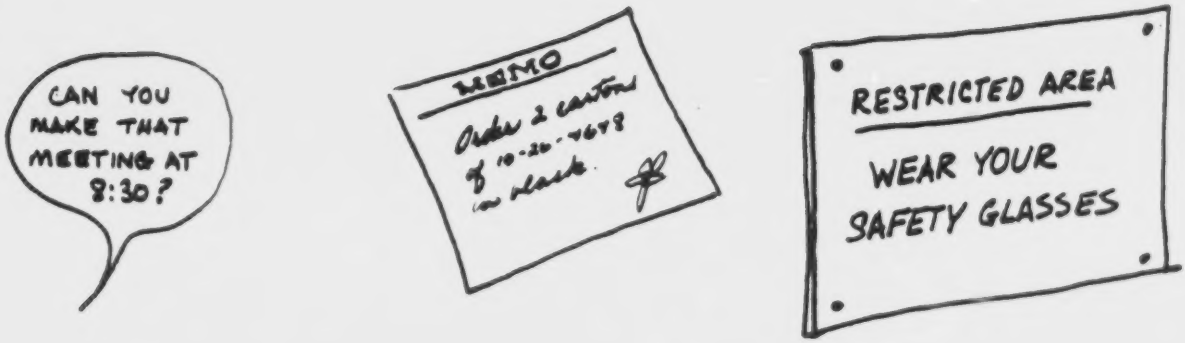
- Can you think of examples of people making mistakes because they did not understand directions and yet did not ask questions? How could the situation have been prevented?

3) (Optional) Ask students to be aware of examples of one-way "communication" and two-way communication for the rest of the day. Have them bring examples they have noticed to class for discussion.

Transparency #1 – Elements of Communication

SENDER

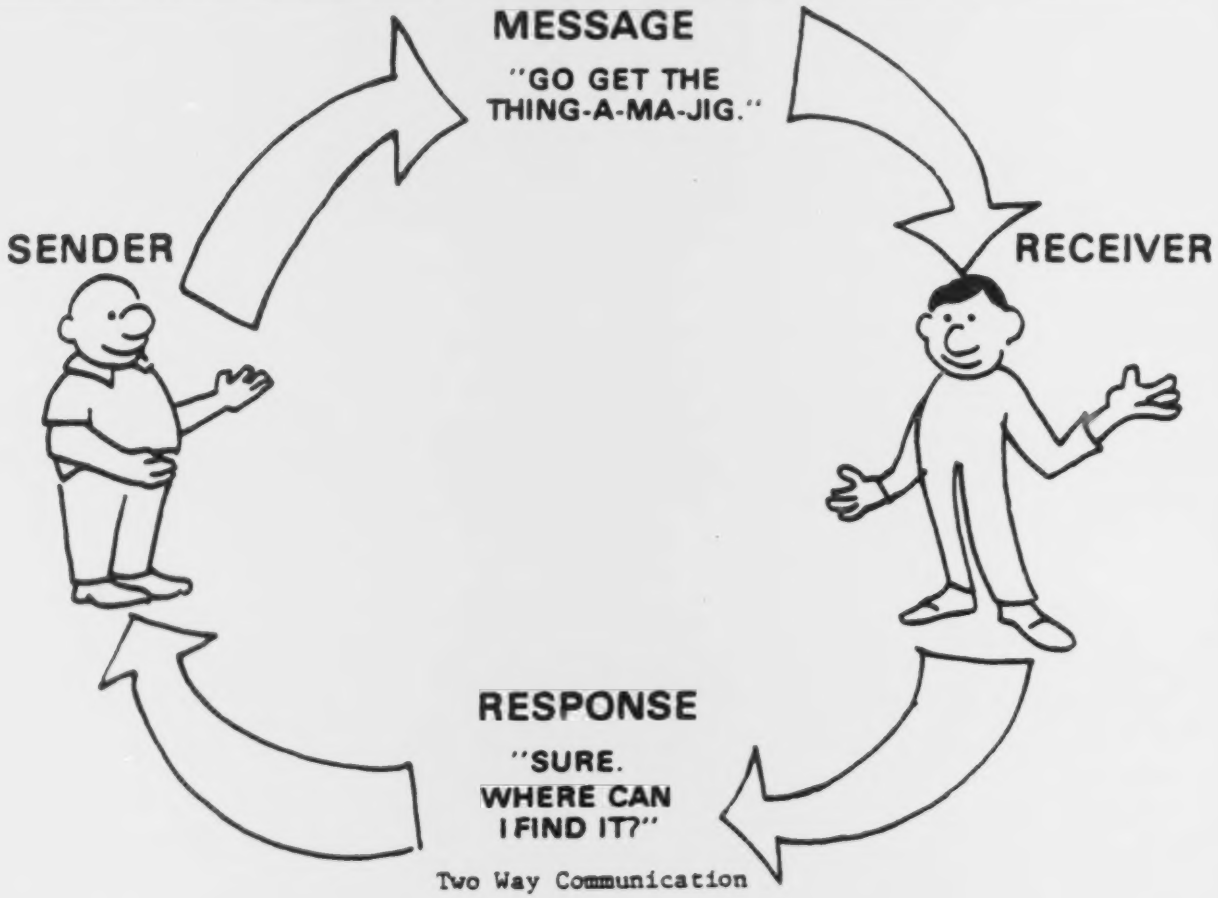
MESSAGE



RECEIVER

Transparency #2 – Two-Way Communication

One Way Communication



Two Way Communication

Exercise 10

Title: Communication Evaluation Exercise

Purpose: To insure that students have an understanding of communications and how they affect the performance of individuals and groups in any setting.

Time: One hour.

Materials: Paper and pencils.

Summary and Rationale: In this exercise students are to design their own experiential activity intended to teach effective communications to some other group. If students are able to put together an activity that incorporates the basics of communications, then it indicates that they mastered the basics of the area.

Procedure:

1) Form teams of five students each.

2) Inform the teams that they are to construct an activity that will teach some important component of communications to a group of students like themselves. Each exercise that is developed must contain the following parts:

   a) Purpose

   b) Time

   c) Materials needed

   d) Summary and rationale

   e) Specific procedures

   Students should be given approximately 45 minutes to do this part of the activity.

3) Two or three teams can then be chosen to present to the class their specific exercises. The presentation should focus on how the activity actually incorporates some principle of communications. The remainder of the class should be encouraged to critique the presentation and make suggestions for improvements.

Suggestions to instructor:

1) Encourage students to be creative. The more they build in movement and interaction the better.

2) The activities that are created can be used on the class. You can pick one of the activities that is especially good and have the entire class do it.

Part 4 – Developing Additional Exercises

In developing exercises for this unit, the following themes should be considered:

Justification: Communications is the thread that holds groups together. Listening, questioning, nonverbal attending, giving information and feedback are features of communications. Success or failure in these areas affects the cohesiveness and effectiveness of a group.

Information: Informational soundness directly affects the clarity and quality of communications. Unreliable information may be clearly expressed, but the validity of the decisions resulting from the communications suffers. Similarly, reliable information poorly communicated also may result in invalid decisions.

Solid problem solving and decision making depend upon accurate information clearly communicated.

Motivation: Individuals who are successful in understanding and applying effective communications -- not only using words, but listening and attending -- are more likely to achieve in group situations. They also are likely to become leaders.

Expected Outcomes: Accurately applying and understanding the model and mechanics of communications to various situations is the ideal outcome.

Some suggestions for activities to emphasize the points above:

- Analyze and compare attending, listening and questioning in situations involving individuals who are very interested in what is taking place in a given circumstance versus those who are not.
- Analyze how a mechanic, physician, lawyer or salesperson develops information by questioning.
- Analyze how people are encouraged and rewarded for communicating. How are they discouraged or punished?
- Examine how emotions affect noise in the communication processs.

Part 5 – References on Communications

Baskin, O.W. and Aronoff, C.E., *Interpersonal Communications In Organizations,* Santa Monica, CA: Goodyear, 1980.

Berlo, D., *The Process of Communication*, New York, N.Y.: Holt, Rinehart and Winston, 1960.

Jones and Pfieffer, *The Annual Handbooks for Group Facilitation, 1971-1987*, San Diego, CA: University Associates.

Saskin, M. and Morris, W. C., *Organizational Behavior: Concepts and Experiences,* Reston, VA: Reston Publishing, 1984.

Schall, M.S., "A Communication Rules Approach to Organizational Culture," *Administrative Science Quarterly*, Dec. 1983, pp. 557-586.

Seiler, W.J., Baudhuin, E.S. and Shuelke, L.D., *Communications in Business and Professional Organizations,* Reading, MA: Addison Wesley, 1982.

"Small is Beautiful Now in Manufacturing," *Business Week*, Oct. 22, 1984, pp. 153-156.

Unit IV: Leadership

Rationale: Life in any organization creates decision-making roles. Those who are leaders must often first decide how to decide. It is not always obvious how to make this decision process work. Leaders often refuse to allow participation and group members often expect too much. Leaders and members both must learn the limits of this process.

Objectives: To understand the process of leadership as it relates both to being a leader and a member of a leader's group. Also, to become familiar with the various styles of leadership and the factors to evaluate when choosing a leadership style.

Student Learning: The student should be able to examine a situation and decide which leadership style is the best one for that situation. The student should also be able to know what style he or she generally chooses in leadership situations.

Contents of this Section:

1) Need statement

2) Background information

3) Exercises

4) References

Part 1 – The Need to Study Leadership

In most organizations the traditional model of leadership has specified that the boss is the decision maker and that the worker is the follower who carries out the commands of the boss. In this situation it is the formal position of the boss that makes him or her the leader. As the demand for improved productivity and quality has increased, it has been realized that this traditional relationship may not be the most effective. It has, in fact, been realized that in many situations the worker has more knowledge and ability than the boss to solve certain kinds of problems, but are prevented from doing so by traditional leadership structures.

One purpose of this section is to identify various leadership styles that can be adopted by leaders (whether formal or informal) in organizations. There have been several approaches to this process and these will be presented. A second purpose is to identify circumstances under which one leadership style may be more appropriate than another. Under the traditional models, leaders tended to use the same approach with people regardless of the situation. There is much evidence to conclude that teachers and managers who can vary their leadership style to match the unique circumstances of a situation are more effective leaders.

To illustrate this, imagine that "hall behavior" in a school is considered to be a problem. Under the traditional model, a school administrator would devise a policy complete with rules and punishments, possibly consult with one or two faculty and then publish it. Using a situational approach to leadership, the administrator would realize that the successful implementation of the policy requires the cooperation of many subgroups in the school and that autocratic decisions on an issue such as this will not be effective. In this case that administrator would probably be more effective using a participative or group style of leadership.

Not all decisions, however, have to be group decisions. For example, an autocratic decision might be appropriate when deciding on a supplier for maintenance materials.

Managers and administrators need to be able to identify situations where they need to exercise an autocratic style, a participative style or in some cases no leadership at all.

An understanding of these concerns is equally important to workers. A realization that leaders can and should choose different styles under different circumstances will lead workers to form more appropriate expectations about how work decisions will be made.

Part 2 – Background for the Study of Leadership Styles

The study of leadership has usually focused on one of two questions:

1) What makes a good leader? Or,

2) What makes a leader good?

Two approaches to leadership will be presented here. The first approach takes into account several situational factors. The good leader chooses a style which best fits the situation. Three styles which can be adopted are:

1) Directive Leadership. This style is similar to that of the authoritarian leader. Subordinates know exactly what is expected of them, and specific directions are given by the leader. There is no participation by subordinates.

2) Supportive Leadership. The leader is friendly and approachable and shows a genuine concern for subordinates.

3) Participative Leadership. The leader asks for and uses suggestions from subordinates, but still makes the decisions.

No one of these styles is appropriate for any situation. The leader must take into account factors relating to the subordinate and the situation.

Some of the specific factors are:

1) Subordinate characteristics
   a) ability
   b) maturity
   c) motivation

2) Situational characteristics
   a) task difficulty
   b) reward system
   c) group norms

The leader chooses a style based on factors he or she feels will lead to the outcomes desired. For example, a subordinate with high ability, working on a relatively easy task, will probably want his/her supervisor to use a supportive style because the subordinate does not need any

help. In fact, a directive style may be viewed as an insult by the subordinate. On the other hand, if a subordinate is not highly skilled, the supervisor may decide that a more directive style would be best.

The main job of the supervisor is to analyze the situation based on the subordinate and situational factors and then pick the best style.

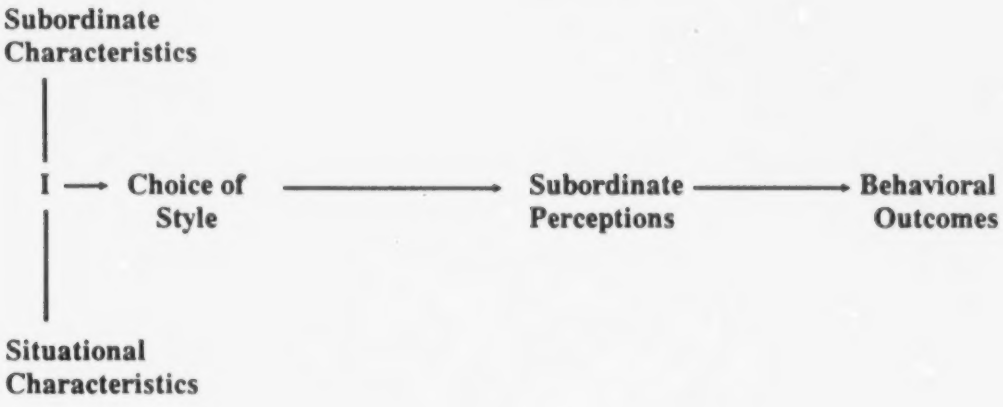
When the supervisor is able to do the job well, the result will be high levels of performance, satisfied workers, and a good understanding of the job by the worker.

Ordinarily, three outcomes are the result of effective leadership:

1) Performance
2) Satisfaction
3) Role understanding

A model can be constructed that shows the relationship among the variables just identified. This model indicates the flow of the leadership influence process.

Figure 17



It is important for both the leader and the subordinate to be aware of this process. If both know a better style for different situations, then each is more likely to expect better behavior of the other. For example, if a worker has high ability on a task, then he or she may expect a supportive leader style while the same worker may expect a different style (either directive or participative) on a task where he or she is less skilled.

It should be clear that the differing styles can and should be used by the same leader in different situations. The resulting outcomes should be better than if a leader uses the same style all the time.

The Use of Participation

The first approach to leadership does not directly talk about how to deal with groups. It is more of a model for dealing with individuals. The second model that will be discussed says the leader must look at every individual decision-making situation and decide whether to decide alone, involve individuals or to involve an entire work group. The leader then asks a series of questions to help make the decision. The questions are as follows:

1) Do I have all the information I need to solve this problem or make this decision?

2) How committed are subordinates to organizational goals?

3) Is acceptance of the decision by subordinates important for effective implementation?

4) If I were to make the decision by myself, is it reasonably certain it would be accepted by my subordinates?

5) Do subordinates share the organizational goals to be attained in solving this problem?

6) Is it likely subordinates will disagree about the best solution?

7) Are there time constraints to nailing this decision or solving this problem?

8) How important is it that I develop my subordinate decision-making and problem-solving skills?

Once the supervisor has reviewed these questions he/she must then decide what level of subordinate involvement would work best. Below are listed five different styles that a supervisor might choose from. They range from a completely autocratic style (AI) to a group style (GII). Not all of the questions above apply to every situation but the supervisor must judge what will work best under specific circumstances.

Also, there is no one best answer to the questions. The leader must be aware that his/her behavior does have broader effects than just on the immediate situation.

The styles that a leader might choose from are:

Style	Definition
Autocratic I (AI)	You solve the problem or make the decision yourself, using the information available to you at the present time.

Style	Definition
Autocratic II (AII)	You obtain any necessary information from subordinates, then decide on a solution to the problem yourself. You may not tell subordinates the purpose of your questions or give information about the problem or decision you are working on. The input provided by them is clearly in response to your request for specific information. They do not play a role in the definition of the problem or in generating or evaluating alternative solutions.
Consultative I (CI)	You share the problem with the relevant subordinates individually, getting their ideas and suggestions without bringing them together as a group. Then you make the decision. This decision may or may not reflect your subordinates' influence.
Consultative II (CII)	You share the problem with your subordinates in a group meeting. In this meeting, you obtain their ideas and suggestions. Then you make the decision which may or may not reflect your subordinates' influence.
Group (GII)	You share the problem with your subordinates as a group. Together you generate and evaluate alternatives and attempt to reach agreement (consensus) on a solution. Your role is much like that of chairperson, coordinating the discussion, keeping it focused on the problem, and making sure that the critical issues are discussed. You can provide the group with information or ideas that you have, but you do not try to "press" them to adopt "your" solution and are willing to accept and implement any solution which has the support of the entire group.

As can be seen, going from style AI to GII there is an increasing amount of worker involvement. In order to choose a style the leader answers each of the eight questions and judges which style would be best.

The process appears complicated at first but is really quite simple. Exercise 2 at the end of the unit provides an opportunity to practice the procedure.

The purpose of the model is not to try to lock the leader into a rigid framework. It is to make him or her aware of a number of factors that need to be considered before moving ahead with decisions involving other people.

Conclusion:

The study of leadership by management theorists and psychologists has lead to the development of many theories. Some of these are very theoretical, others are quite applicable. If one lesson is to be learned from any of this work, it is that no one style of leadership is right for all situations. In order to be a good leader, one must examine the situation and decide how the needs of the problem and the people can be best served. To be a good employee, it must be accepted, also, that under certain conditions a leader may and should use a participative style, while under other conditions a more authoritarian style will be used.

Part 3 – Exercises

Exercise 1[17]

Title: Situational Leadership

Purpose: This activity was designed to illustrate the effects of different leadership approaches in similar and in different types of situations. Although most people agree that leaders need to vary their behavior depending on the nature of the task, the subordinate, or some other situational factors, it is not always clear just what leader behavior is best for which situation. The following exercise explores this issue.

Time: One hour.

Materials: Task and role information sheets; a large room with movable chairs; pens or pencils.

Procedure:

1) Explain that this exercise is designed to explore some of the ideas about how leaders ought to act in various situations. A review or lecture on the contingency and situational control theories of leadership is desirable at this time.

2) Divide the class into six groups, and number each group one through six. Each group must have two or more members. One person will be leader while the remaining members will be workers. Leaders of groups 1 and 4 read "Leader Assignment X." Leaders of groups 2 and 5 read "Leader Assignment Y." Leaders of groups 3 and 6 read "Leader Assignment Z." Workers in groups 1, 2, and 3 read "Task Assignment 1," while those in groups 4, 5 and 6 read "Task Assignment 2."

3) Each group moves to its own area of the room to begin work on the task assignments.

4) After 15 minutes everyone stops. The entire class discusses what happened, and members of each group respond to the instructor's questions about how productive the groups were, and how effective the leaders were.

17 Adapted from Saskin and Morris.

Discussion Questions:

- Were some groups more productive than others? Why?
- Were some leaders more effective than others? Why?
- What effect did task characteristics have?
- Was one particular leadership style more effective than others, regardless of the task characteristics?
- What could leaders have done, initially, to improve their chances of success?

Situational Leadership

Leader Assignment X

You are to supervise students in identifying and writing applications of their classroom learnings. The students you will be supervising are not at all sophisticated and will need extensive and detailed directions from you if they are to accomplish their task assignments. Try to outline for them the best approach to take in the assignment. Check frequently to see how they are doing and give them feedback.

Leader Assignment Y

You are to supervise students in identifying and writing applications of their classroom learnings. Since these are your peers, you should use a friendly and helpful approach with them. Encourage them to do their best, and tell them how well they are doing whenever any progress is made. You should not try to tell them just how to accomplish the task - that is their job. Just be as helpful and supportive as you can.

Leader Assignment Z

You are to supervise students in identifying and writing applications of their classroom learnings. To help them accomplish this task, you will have to provide considerable direction and instruction, as well as a lot of support and encouragement. Try to outline for them the best approach to take with the assignment. Give frequent encouragement, and praise them whenever someone makes progress.

Task Assignment 1

Your assignment is to identify how to apply what has been learned in this class. Use the space below.

Task Assignment 2

Your assignment is to identify five specific things that you can apply in the real world; base your answers on what you have learned about leadership. Each application should be clearly related to or implied by a specific theory or learning from this chapter. Your applications should be concrete and should refer to your own real experiences. Use the space below.

Exercise 2

Title: Determining Leadership Style

Purpose: The purpose of this exercise is to have students rate the behavior of a leader and then classify that leader according to his or her style. Anyone can be used for this process: a church leader, a teacher, a social club leader, a boss at work, etc. As a variation the student might also rate his or her own behavior in leadership situations.

Time: 15 minutes.

Materials: Leader Behavior Questionnaire; pens or pencils.

Procedure:

1) Have individuals choose a leader with whom each is familiar.

2) Using the following questionnaire, have each student rate that leader on the 15 items.

3) Score the leader using the key at the end of the questionnaire.

Leader Behavior Questionnaire

Person described_____

For each statement, enter the number which best describes your perceptions of your leader using the following response codes:

5 = Always 4 = Often 3 = Occasionally 2 = Seldom 1 = Never

_____ 1) Lets group members know what is expected of them.

_____ 2) Is friendly and approachable.

_____ 3) When faced with a problem, consults with others in the group.

_____ 4) Decides what shall be done and how it shall be done.

_____ 5) Does little things to make it pleasant to be a member of the group.

_____ 6) Before making a decision, gives serious consideration to what others in the group have to say.

_____ 7) Makes sure that leader's part in the group is understood.

_____ 8) Puts suggestions made by the group into operation.

_____ 9) Asks subordinates for their suggestions concerning how to carry out assignments.

_____10) Schedules the work to be done.

_____11) Treats all group members as equals.

_____12) Before taking action, consults with others in the group.

_____13) Maintains definite standards of performance.

_____14) Gives advance notice of changes.

_____15) Asks others in the group for suggestions on what assignments should be made.

Scoring:

___Directive Leadership (facilitating task performance, clarifying path-goal relationships). Add scores for items 1, 4, 7, 10, 13.

___Supportive Leadership (consideration of needs and opinions of other group members: concern for good relationships). Add scores for items 2, 5, 8, 11, 14.

___Participative Leadership (involvement of other group members in planning and executing group decisions). Add scores for items 3, 6, 9, 12, 15.

Scores: Possible range = 5 (low) to 25 (high) on each scale.

Discussion Questions:

- Did your leader end up being described the way you would have expected?
- For the entire class did one style show up more often than others? Why?
- Can a leader have high scores on more than one dimension? Why or why not?

Exercise 3

Title: Choosing a Leadership Style

Purpose: The purpose of this exercise is to give students an opportunity to examine a series of leadership cases and decide which style is most appropriate for each situation. The basis for the case analyses will be the questions introduced on page 97.

Time: One hour.

Materials: Questions on page 97, case studies.

Procedure:

1) Each student should read the cases individually and decide which style of leadership (AI, AII, CI, CII, or GII) is best for each situation. They should record their decisions.

2) Form groups of four or five students.

3) Groups should then re-analyze each case using the questions provided in the text to guide their decisions.

4) Groups should then discuss any differences between the individual "gut" choice of style and the style chosen as a result of using the questions.

Discussion Questions:

- Was there agreement among groups on which style is appropriate for each situation?
- Was there difference between the individual decisions and the group decisions?
- Which questions were the hardest to answer?

Case I

You are general foreman in charge of a large gang laying an oil pipeline. It is now necessary to estimate your expected rate of progress in order to schedule material deliveries to the next field site.

You know the nature of the terrain you will be traveling and have the historical data needed to compute the mean and variance in the rate of speed over that type of terrain. Given these two variables, it is a simple matter to calculate the earliest and latest times when materials and support facilities will be needed at the next site. It is important that your estimate be reasonably accurate. Underestimates result in idle foremen and workers, and an overestimate results in tying up materials for a period of time before they are to be used.

Progress has been good, and your five foremen and other members of the gang stand to receive substantial bonuses if the project is completed ahead of schedule.

Case II

You are the supervisor of 12 auto mechanics. Their training and experience are very similar and allows you to use them interchangeably on jobs. Yesterday your supervisor informed you that your service facility was going to begin an all night auto repair service on a highway location. This is to be an experiment that will last for at least six months.

From your perspective this assignment would be considered undesirable. All your mechanics are capable of handling this assignment and from your standpoint, there is no reason why one should be chosen over another.

Case III

You are the new quality control manager in a large plant and work on a wide variety of problems of both a technical and administrative nature. You have been given the job of developing a method of quality reporting for each of the seven departments in your plant.

Until now, there has been a high error rate in the recording and transmission of data. Some departments have considerably higher error rates than others, and the methods used to record the data vary between departments. It is likely, therefore, that part of the difference in error rates stem from local conditions rather than anything else. This fact will probably make setting up a single system more complicated. You have the information on error rates, but little information on the specific practices that cause these errors or why the different methods were set up in the first place.

All the people involved in this situation would benefit from improving this situation since the data are used in making some important decisions. The quality control technicians in each department are responsible for collecting and transmitting quality data. They are a conscientious group who want to do their jobs well. They are, however, very sensitive to interference on the part of higher management. Any solution that does not receive the active support of the various technicians is unlikely to reduce the error rate significantly.

Case IV

You are the head of a school committee to select textbooks for a school district. You have been asked to provide a report on the procedures to select science textbooks for the district. Some doubts have been raised about the difficulty of the existing system and a number of people are dissatisfied with some of the past suggestions.

You plan to write the report but are not sure about how to go about doing it. Your own area is social studies, and it is clear that a knowledge of science is necessary to write this particular report. Fortunately, four members of your committee are science teachers and have a lot of experience in this area. Together they possess the information that you need, but they seldom agree about the best way to go about this activity. Although they care about their work and are knowledgeable, they have major differences in philosophy about textbook selection.

You have three weeks before the report is due. You are somewhat familiar with the process already and know the overall district process for textbook selection. Your present problem is to come up with some alternatives to the present practices and select the most promising for detailed analysis in your report.

Case V

You are part of an eight-student committee that is to help to plan a visit to your school and community by a group of 25-30 foreign students. The visiting students are from Europe; they are about the same ages as members of your committee. There will be males and females from about 20 different countries.

The pupose of the visit to your school -- and three others in very different parts of the U.S. -- is to see first-hand one example of an American school. Also, there is an intent to help the foreign students understand the settings, that is, the communities and backgrounds of the schools and students that they visit.

The visitors, by the way, will be at your school and community for three days and three nights. There will be some language difficulties, but not barriers, to communications.

Your committee is almost equally divided about what the visitors should see and do. One faction pushes for showing the visitors student life: what American students do day to day, what

the schools are like, what their homes are like and how they socialize -- take them to a dance or a river party or barbeque. This group would like to have the visit very structured.

The other faction does not mind having some traditional parties, but wants to have the visitors see what is being learned in school; understand the local history (realize that the host families came mostly from Europe at some time). This group wants to give the foreign students time to explore on their own and ask many questions. It prefers limited structure.

The first faction wants to show the foreign students what happens to students of their age in America; the other wants to show them what comes about as well as how and why they occur.

There is no assigned leader of the committee. The two factions are getting farther apart. There are two weeks to decide the itinerary. You feel that you have to act or your school will look unprepared for the visitors. How do you go about this action?

1) Which faction do you prefer?

2) What do you do to bring about cohesion between the two factions?

Exercise 4

Title: Leadership Evaluation Exercise

Purpose: To ensure that students have an understanding of leadership processes and how those processes affect group performance.

Time: One hour.

Materials: Paper and pencils.

Summary and Rationale: In this exercise, students are to design their own experiential activity intended to teach leadership processes to some other group. If students are able to put together an activity incorporating the basics of leadership, then it indicates that they mastered the basics of the area.

Procedures:

1) Form teams of five students each.

2) Inform the teams that they are to construct an activity that will teach some important component of leadership to a group of students like themselves. Each exercise developed must contain the following parts:

   a) Purpose

   b) Time

   c) Materials needed

   d) Summary and rationale

   e) Specific procedures

   Students should be given approximately 45 minutes to do this part of the activity.

3) Two or three teams can then be chosen to present to the class their specific exercises. The presentation should focus on how the activity actually incorporates some principle of leadership process. The remainder of the class should be encouraged to critique the presentation and make suggestions for improvements.

Suggestions to instructor:

1) Encourage students to be creative. The more they build in movement and interaction the better.

2) The activities created can be used on the class. You can pick one of the best activities and have the entire class do it.

Part 4 – Developing Additional Exercises

In developing exercises for this unit, the following themes should be considered:

Justification: Leaders appear in all groups. How effective they are depends on the personal style of leadership in relation to the situation at hand. Knowing leadership styles and how they are implemented will aid a leader or help others to assist the leader to improve.

Information: Leadership style affects the kind and amount of information that a leader has available to him. An authoritarian leader must rely primarily on his own resources. A consultative or group style of leader can generate more diverse sources of information for decision purposes.

Motivation: Organizations reward individuals who take on leadership roles or who emerge to assist leaders. Being able to apply leadership concepts appropriately or to be supportive of another constructively is a personal and employment asset.

Expected Outcomes: Recognition of different leadership styles in different situations is an important ability. Skill in applying them is a desirable outcome.

Some suggestions for activities to emphasize the points above are:

- Analyze and compare leadership styles of school staff members. Discuss relative degrees of effectiveness. (Use the questionnaire.)
- Identify a prominent local, state or national leader. Assess his or her leadership style. Try to determine in what situations that leadership style is effective or ineffective.
- Identify strengths and weaknesses of the autocratic, group and consultative styles. What rewards do subordinates receive from each of the styles?

Part 5 – References on Leadership

Bass, B. M., *Stogdill's Handbook of Leadership*, Revised Edition, Riverside, NJ: Free Press, 1981.

Bass B. M., "Leadership: Good, Better, Best," *Organizational Dynamics*, Winter 1985, pp. 26-40.

French, J. R. P. and Raven, B., *The Bases of Social Power in Group Dynamics*, 2nd ed., ed. D. Cartwright and A. F. Zander, Evanston, IL: Row Peterson, 1960, pp. 607-623.

House, R. and Mitchell, T. R., "Path-Goal Theory of Leadership," *Journal of Contemporary Business*, Autumn 1974, pp. 81-98.

Vroom, V. H. and Yetton, P. W., *Leadership and Decision Making*, Pittsburg: University of Pittsburg, 1973.

"Why Herb Kellerher Gets So Much Respect from Labor," *Business Week*, September 24, 1984, pp. 112, 114.

Yukl, G. A., *Leadership in Organizations*, Englewood Cliffs, NJ: Prentice Hall, 1981.

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Unit V: Systematic Problem Solving

Rationale: In order to bring about advances in productivity and quality in the workplace, a solid approach to problem solving must be put in motion. Problem solving is the key to effective change in any setting. The critical point, however, is not haphazard problem-solving. Casual, haphazard problem-solving may work in some or even many instances. At issue is systematic problem-solving enabling groups to work together toward a desired solution.

Objectives:

To introduce and examine a six-step problem-solving model.
To use basic statistics to demonstrate information needed for problem solving.
To display basic statistical information in an understandable way.

Student Learning:

Students will be able to:

Break down problem solving into basic steps.
Participate in and contribute to problem-solving groups.
Understand basic statistical descriptions.
Understand basic charts and graphs of statistical material.
Understand the use of basic statistics and charts.

Contents of the Section:

1) A systematic problem-solving model

2) Basic descriptive statistics

3) Basic charts and graphs

4) A practical application of statistics and charts

This section is arranged somewhat differently from the others. Information and exercises are mixed together in the parts dealing with problem solving. As you progress through that topic, you will find that the arrangement makes sense.

Systematic Problem Solving

People solve problems every day -- whether they are trying to locate an address in an unfamiliar part of town or deciding how to motivate students or workers to perform better. Problem-solving approaches used in these everyday settings are usually not systematic. That is, no attempt is made to gather information on past situations, generate sufficient solution alternatives or evaluate the effectiveness of the final solution.

While the informal or non-systematic approach works reasonably well in our everyday lives, the complex and often expensive problems found in modern education and work settings require a more organized approach.

This is true for a number of reasons. First, often people are not able to define the real problem they should be dealing with and thus spend a great deal of time and energy trying to cope with the problem's effect or effects. Second, due to the complexity of many problems, a structured process is needed to insure that a large number of factors are considered prior to arriving at a final solution. Finally, higher management must often approve a solution to a problem before it can be implemented. Thus, a formal process generally allows the problem-solving group to gather evidence on various solution options and put that evidence together in a convincing way.

There are, of course, many skills that are required other than simply knowing the parts of a problem-solving model. Skills in data analysis are needed as well as oral and visual presentation skills. A well thought out and potentially useful solution may not be approved if it is not well presented or explained.

An example of the formal problem-solving approach might be developing a strategy to foster interarea involvement among various vocational programs. By using a formal approach, a detailed problem definition can be established, which will lead to an understanding of the kinds of data to be collected.

One advantage of a carefully applied problem-solving approach is that problems often get redefined based on new information. In the preceding example, one outcome of the analysis might be that interarea involvement is not needed, but that another form of enriching experience might be more useful for students.

There are many models for problem solving. Some are entirely mathematical and abstract. The most useful for our purposes, however, is one that is understandable in our day-to-day language and needs.

It is helpful to recognize that a problem is a situation needing or requiring some change in order to be more desirable for some purpose. Seeing that a problem is a situation -- a condi-

tion out there in the surroundings -- the problem solvers can attack the parts of the problem setting.

Problems, by the way, are not necessarily negative. Usually we are faced with having to do something under stress or demand. But problems can be positive -- how to make something that is satisfactory even better, for instance.

Most people would agree that there surely is no shortage of problems requiring attention. Problems are everywhere in all sizes and shapes. The solutions to problems provide real opportunity for improvement.

There are many different views about problem solving. One view is that common sense coupled with intelligence and experience, will lead to a high quality solution. Another view is that the quality of thinking that goes into problem solving is greatly influenced by the approach to the problem and the processes used to solve it. This package for problem solving stresses simplicity, but at the same time is based on the assumption that the methods and processes used are critical to good solutions.

The approach to problem solving offered here has six steps. There is nothing magical about six steps. Each step, however, is related to a way or phase of thinking about a problem situation and how to set up a change process.

The steps are:

Define the problem

Investigate facts

Determine cause

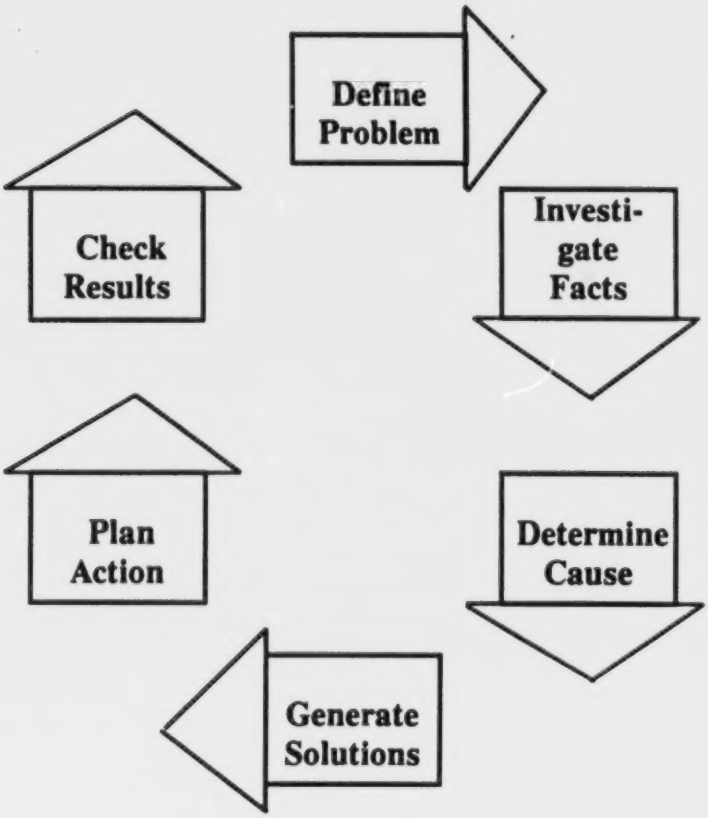
Generate solutions

Plan action

Check results

The following diagram shows an important feature of systematic problem-solving. The process is circular. That is, as a problem is beginning to be analyzed or even as it is worked through, a new problem or a new feature of the old problem may appear.

Systematic Problem Solving



Part 1 – Define Problem

Because a problem is a situation -- a condition in an environment -- problem definitions should specify parts of a setting that are or seem to be involved.

Elements of the problem that first should be identified are:

The setting or location where the problem occurs.

The object(s) involved.

The action taking place.

Exercise 1

Title: Define Problem

Purpose: This exercise will inform the students how to form a problem statement using basic elements of description.

Time: One hour.

Materials: Paper, pencils or pens. Handouts: case study, layout diagram and worksheet.

Students will have to be able to sit in small groups.

Procedure:

1) Before you tell your students about the essential parts of a problem statement, have them describe two different problems as they see them. Instruct them to use one sentence to describe the problem. Select a few students to read their problem statements.

2) Group the students into small teams -- three or four members.

3) Describe the elements of a proper problem statement.

4) Have the team members help each other refine one problem statement from each member using the three elements of description. The problem statements should show a significant change, such as:

Poor statement:

"The **vending machines** in the **school break down.**"

OBJECT is general LOCATION is general ACTION is general

Better Statement:

"The **candy machine** in the **cafeteria** takes coins but **won't dispense** candy."

OBJECT is specific LOCATION is specific ACTION is specific

5) Discuss any questions that the students have about proper problem statements.

6) Hand out the case study, layout diagram and worksheet to each student in the teams. Describe each of the handouts.

7) Have each student read the case situation and, then, fill out the worksheet. These may differ within teams. Have the teams decide what problem statement to work on. (Communications from the preceding unit comes in here.)

8) Have students save their handouts. They will be used in later exercises.

Case Study

You are members of a joint faculty/student problem-solving group that has been chartered to analyze a growing concern of all school residents. Over the past six months, students and faculty have expressed dismay over the cleanliness of the cafeteria during and after the lunch period. At the one 60-minute lunch period, an average of 110 students use the cafeteria line for hot lunch. At the end of the lunch hour, papers, bags, and cartons litter the tables and floors. Trays with food and plates cover the tables in spite of signs asking that trays not be left on the tables. Pools of milk and soda stand in the self-serve line and liquid is tracked on shoes to the table.

Expressions of concern left on a school "Dial An Issue" hotline include:

"I am so disgusted with the messy cafeteria during lunch hour that I have stopped eating on campus."

"Can't something be done to deal with those people who don't give a darn about the cleanliness of our cafeteria?"

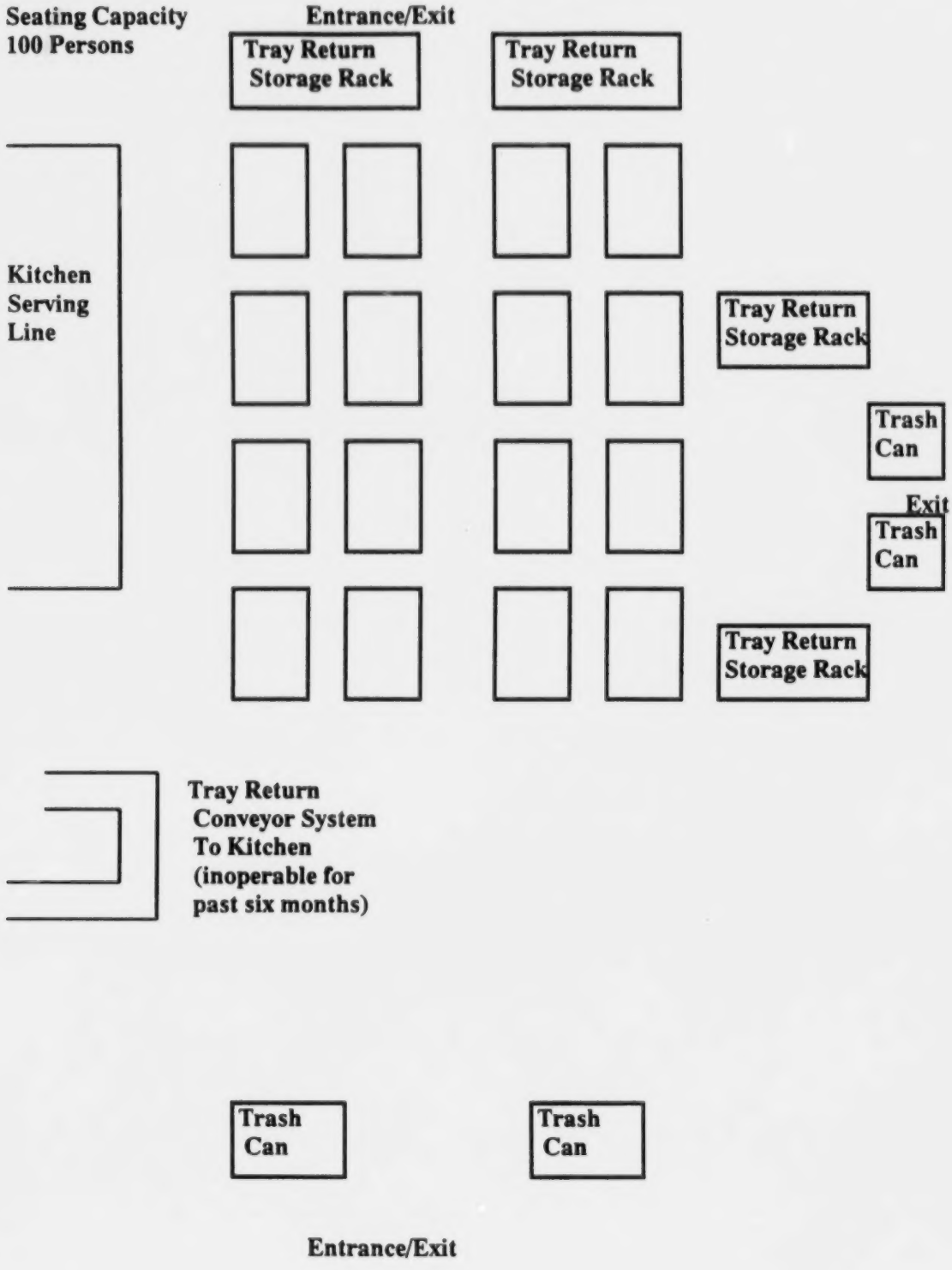
"If our cafeteria cleanliness is any indication of school pride, we have dropped to a new low."

"It has been 10 years since the cafeteria has been painted -- how about springing for a few paint brushes and cans of paint? Also, why aren't the burned out ceiling lights replaced -- are you trying to keep us in the dark?"

"Why don't you replace the self-serve milk and pop machines? They have been leaking since they were installed."

"Let's go back to a supervised lunch. Student's can't handle the responsibility of an orderly lunch without teachers watching over them."

"I am not into body building, so why do I have to press heavy metal food trays to get them into overcrowded tray holders?"


Seating Capacity
100 Persons
Entrance/Exit
Tray Return
Storage Rack
Tray Return
Storage Rack
Kitchen
Serving
Line
Tray Return
Storage Rack
Trash
Can
Exit
Trash
Can
Tray Return
Storage Rack
Tray Return
Conveyor System
To Kitchen
(inoperable for
past six months)
Trash
Can
Trash
Can
Entrance/Exit

Definition Worksheet

1. State the problem as you see it now:

_____
_____
_____
_____
_____
_____
_____

2. Restate the problem using specific information: situation/object, action, location.

_____
_____
_____
_____
_____
_____
_____

3. Does your problem statement have a specific:

Situation	**Yes** _____	**No** _____
Action	**Yes** _____	**No** _____
Location	**Yes** _____	**No** _____

If you have answered "No" to any of the above, restate the problem.

_____
_____
_____
_____
_____
_____
_____

Part 2 – Investigate Facts

Problem solving, to be sound, must be based on facts and observable information. The problem statement must be fleshed out with facts. What facts? The following questions are important in collecting usable information:

What is the object of concern? What has changed about it since before the problem occurred?

Where is the location of concern? What other location factors are there?

When is it occurring? What are other time factors?

Who are the people involved? What are other people factors?

How is it occurring? What methods or procedures are involved?

What is the range of the problem?

The answers to these questions should be detailed and specific. It is especially important to keep in mind for each question -- "What makes the situation different now from before?" Usually the key to finding solutions depends on recognizing changes in the problem situation over time.

Exercise 2

Title: Investigate Facts

Purpose: To sort information to gather evidence and results that relate to a problem.

Time: 45 minutes.

Materials: Paper, pencils or pens. Handout: Investigation Worksheet. (Students will need their previous handouts.)

Procedure:

1) Be certain they have the earlier work materials.

2) Refer the students to the written case study. Give them the Investigation Worksheet. Have them examine the case study and fill in the facts that they find on the worksheet. Each student should work alone.

3) Have the students rejoin their groups and compare the lists of facts they have gathered.

4) Discuss the lists as a class. Direct the teams to look again at their original problem statements. Do they need to be altered or refined as a result of facts obtained? If so, ask that they restate the problem definition.

Investigation Worksheet

Problem Statement:

What **Changes?**	**Where** **Changes?**
When **Changes?**	**Who** **Changes?**
How **Changes?**	**Range** **Changes**
What objects are not having problems?	**Where, when is problem not occuring?**

Now that the facts have been collected, does the problem look different to you?

New problem statement, if needed:

Part 3 – Determine Cause

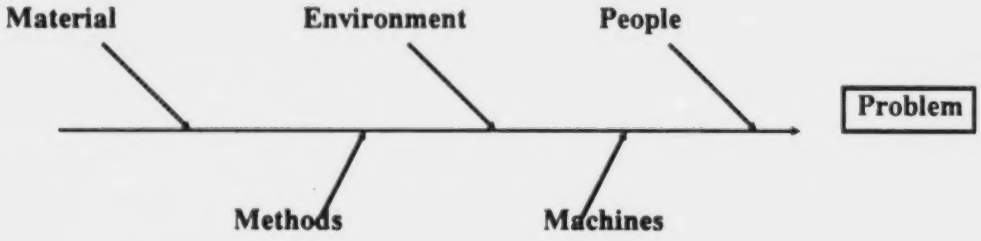
The emphasis to this point has been on developing problem statements that have observable elements in them. Factual information has been stressed. The purpose of this effort has been to encourage a systematic approach to problem solving.

The facts now must be put together so that the root cause or causes of a problem can be seen. Care must be taken to look for root or main causes of a problem, not the effects of that problem. For example, the complaints logged in the case study were effects of a problem, but can cloud detecting the cause(s). Problems are caused -- are made to happen.

At any one time there will be one or a few causes behind the present problem. Because our purpose is to identify the cause so we can eliminate it, we need to find out what the possible causes are:

Figure 9

Causes can be put into categories.



MACHINES--machinery, technical equipment, software, mechanical devices

METHODS--policies, practices, procedures, rules, structures, standards that affect the problem

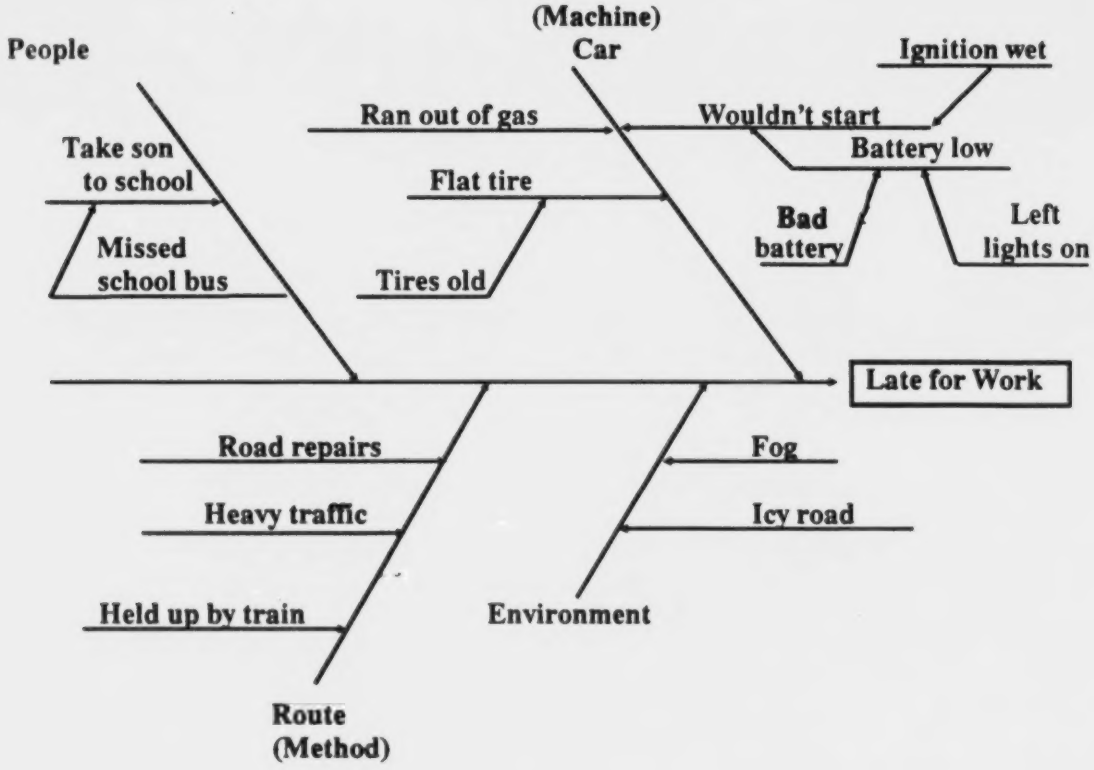
ENVIRONMENT--physical surroundings, climate, cultural setting that affects the problem area

PEOPLE--numbers, makeup, attitudes, skills, qualities that affect the problem area

MATERIALS--raw material, information, facilities that affect the problem area

Below is an example of the use of the flow chart in diagnosing the factors that contributed to the problem of being late for work one morning. Notice the events that led into larger factors, e.g., the flat tire.

Figure 10



No raw manufacturing materials were involved in this problem situation. That element therefore does not appear in the diagram and example in Figure 10.

Exercise 3

Title: Determining Causes

Purpose: To demonstrate a technique to find or determine why a problem is occurring -- its cause.

Time: 45 minutes.

Materials: Pencils or pens and paper. Handouts: Cause Worksheets. Previous work materials.

Procedure:

1) Explain the five categories that possibly cause problems. Use the simple flow diagram to help them see the relationships. You may want to use the "Late for Work" problem to help illustrate the relationships -- or, certainly you can make up one of your own. Display your example on the chalkboard or newsprint so that all may see and discuss it.

2) Have the students rejoin their groups. Distribute the Cause Worksheets. Go over the worksheets with them.

3) Give the students time to assemble the facts that they have collected (previous exercise) and place them on their flow diagrams.

4) Instruct them, then, to work as a team to produce one diagram and to come to agreement on the root cause of the cafeteria problem.

5) Be available to the teams to help them find ways to come to agreement.

6) Open a discussion of the process and the teams' conclusions after 40-45 minutes or sooner, if the teams complete the diagrams.

7) Have the teams, again, save their worksheets.

Cause Worksheet

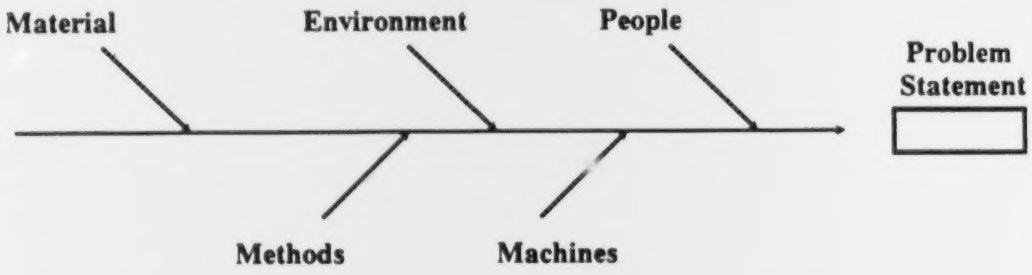
Instructions:

Please note that the blank flow diagram form is for you to fill out.

1) Write the problem statement in the space on the right side of the cause diagram.

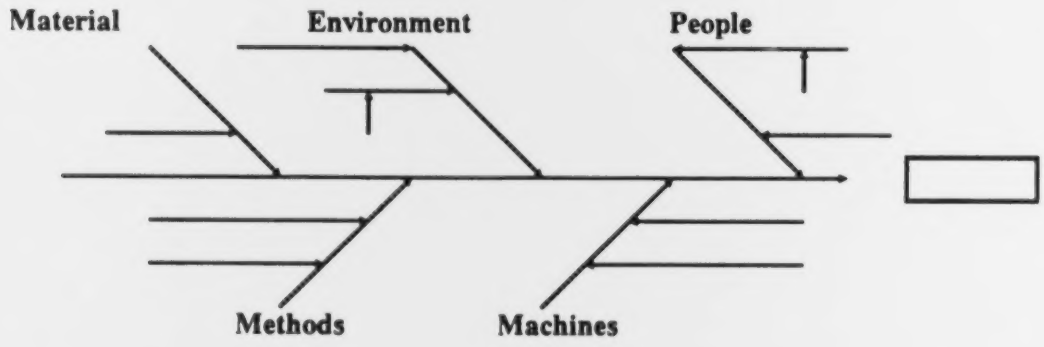
2) Write in the major causes on the diagram as in the example below.

Figure 11



3) Individually, write the facts that you have collected about the problem under the major cause headings. You may see that some causes relate to others (as in the "Late for Work" problem). Your diagram may start to look like the example below.

Figure 12

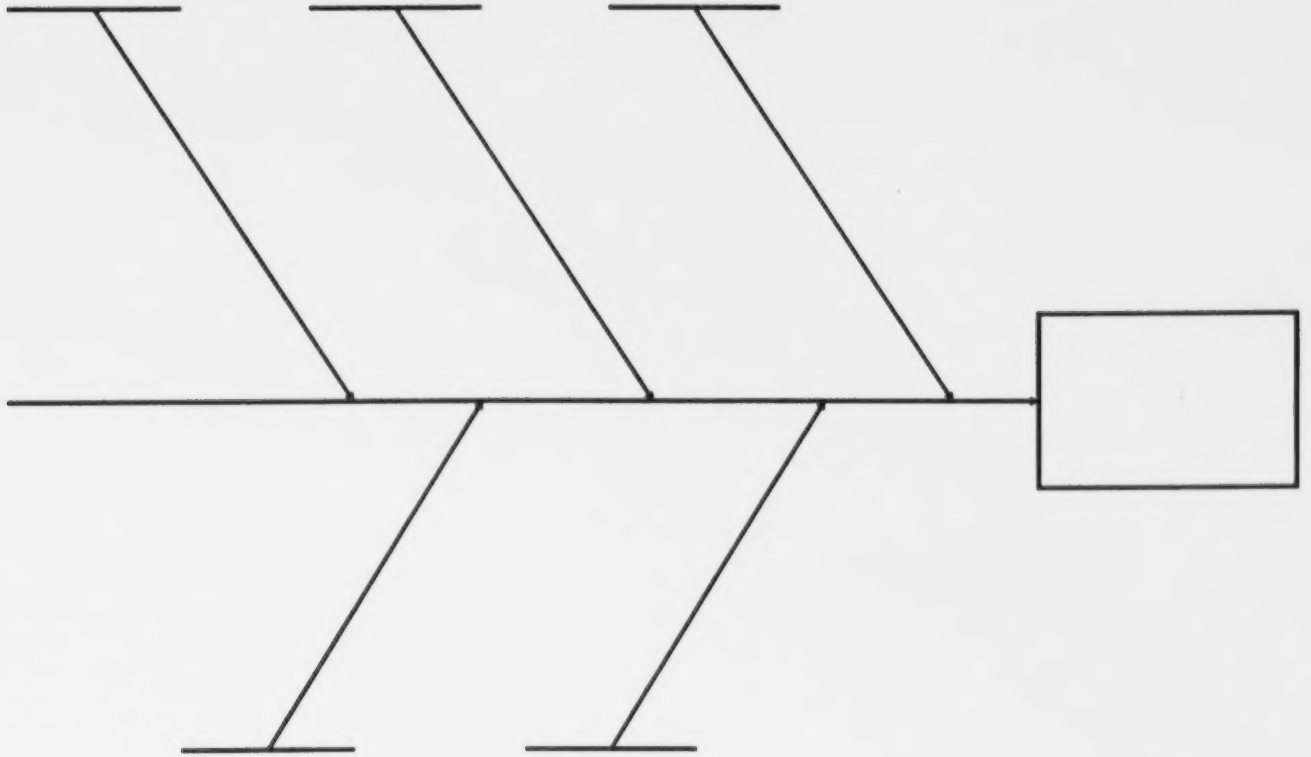


4) Brainstorm possible causes and link related causes. Then, as a team sort out the likely from the less likely causes. If you cannot agree, the team members should vote on the matter. If you decide to eliminate a cause, put a light "X" through it. Do not erase it. Later, you may decide that it was important.

5) Review the most likely causes against all the facts and data and the problem statement. Come to agree on the "root" cause. The team should reach consensus, that is, an agreement that all can "live with," even though there may be some small disagreement in the team.

   Specifically state the root cause below:

Cause Worksheet



Part 4 – Generate Solutions

Group processes have been important parts of this problem-solving exercise. They are especially important in generating solutions that address the identified causes.

The "brainstorming" approach (see Unit II -- Group Processes) to find possible solutions to a problem is applicable. It is important to get ideas "out on the table," then discuss and evaluate them. Brainstorming is best done in a group, although it is possible to do it individually in some instances. Effective brainstorming in a group or team requires certain conditions. Team members are expected to:

1) State any ideas that come to mind.

2) Accept all ideas -- withhold judgment of ideas.

3) State different ideas from others in the team.

4) Enjoy the process. It is not to be a painful or defensive activity.

5) List about 10-15 ideas or until the team's energy runs out. Quantity of ideas is to be stressed at this point in the process -- quality later.

Once ideas for possible solutions are on paper, the evaluation process can begin. Each alternative solution should be discussed along the lines of the following issues:

- How will this idea resolve the cause of the problem?

- How many resources are required to use this idea?

- How much time will it take?

- Can the results be measured? If yes, how?

- How can you be sure it will work -- specifically?

Possible solutions may then be rated or evaluated in a more objective manner. The evaluation should not be global or total for any solution alternative. It should address specific issues. For each possible solution the questions to be asked are:

- Will it lead to a long-term elimination of the problem?

- Is it practical -- can needed resources be acquired?

- Is it timely -- can it be done in the necessary time frame?

- What is the chance or probability of success?

The total process described above is designed to encourage team members to offer ideas in a non-judgmental setting, objectively look at the ideas that have been generated and to gain commitment from the team members to cull ideas to find the best workable solution(s).

Exercise 4

Title: Generate Solutions

Purpose: To identify a solution that will address the cause and, thus, eliminate the problem.

Time: One hour.

Materials: Pencils or pens and paper. Handout: Solution Worksheet. All previous worksheets.

Procedure:

1) Orient the students to the points made in the opening of this section. A handout of your own may be useful.

2) Have the students return to their team situations and review their last exercise findings on the cause they found to the problem.

3) Begin team brainstorming to identify possible solutions to the cause they identified. Have them record the solutions on the worksheet.

4) Have them discuss the pros and cons of each solution and record those on the worksheet.

5) Instruct the teams to rate each of the solutions using the table on the worksheet, then total the column for each solution. (If a team has more than five possible solutions, it can add to the table.)

6) Have the teams write the best solution on the worksheet.

7) Open a discussion about the process and the findings of the teams.

Solutions Worksheet

Problem Statement:

_____

_____

Cause Statement:

_____

_____

Step 1. State alternative solutions:

_____

_____

_____

Step 2. Discuss merits of all alternatives, noting significant pros and cons:

_____

_____

_____

Step 3. Rate each alternative solution on a 1-10 scale using the four criteria listed below. A "10" rating is the most positive rating.

	Solutions				
	A	B	C	D	E
	Rating	Rating	Rating	Rating	Rating
1. Will it lead to long-term problem elimination?					
2. Is it practical -- can resources be acquired?					
3. Is it timely -- can it be done in the necessary time frame?					
4. What is the probability of success?					
Total Rating	____	____	____	____	____

Based on ratings and other discussion, specifically state the best solution:

_____

_____

Part 5 – Plan Action

The systematic, problem-solving steps taken to this point have permitted problem recognition and definition, investigation for facts surrounding the problem, determination of cause and the development of a solution to the problem. These steps do not complete the systematic process. Even though a solution has been settled upon, acting on that solution requires a careful plan.

A plan of action to accomplish the designated solution includes all the activities seen to be necessary to reach the solution, the sequence in which they will occur, the responsibility for seeing that they happen, and the assessment or measurement of the results. Four main questions must be asked -- and answered:

- What activities will happen?
- Who -- what person or group -- will be responsible for each activity?
- When will each activity take place? Which will happen first, second, third, and so on?
- How will the results of each activity be measured?

It is helpful to get a visible, step-by-step plan to track the completion of the plan. Typically, an "Action Chart" may be used. An example of an Action Chart is given below.

Figure 13

Activity	Week 1/2	Week 1/9	Week 1/16	Week 1/23	Week 1/30	Week 2/6	Week 2/13	Responsibility
Buy Equipment	←	—	→					John
Install Equipment		←	—	→				Mike
Receive Final Blueprints				←	—	→		Joe
Order & Machine Castings		←	—	—	—	—	→	Fred
Finalize Inspection Techniques					←	—	→	Pete
Audit Process						←	—	Bob

All information about each activity should be included on the chart. The issue of measurement need not appear, but it is critical to have it performed by the responsible party. Each person involved in the Action Plan should have a copy for his own planning and time management. Weekly review should take place to keep all involved up-to-date on the progress of the planned action. Such review will allow anyone to raise concerns or difficulties in carrying out his or her responsibilities.

Exercise 5

Title: Plan Action

Purpose: To identify the activities needed to implement the solution, when the activities will occur and who will be responsible to carry them out.

Time: 45 minutes.

Materials: Pens or pencils and paper. Handout: Action Planning Worksheet. Previous exercise materials.

Procedure:

1) Orient the students to points made in the opening of this section.

2) Have the students return to their teams and review their last exercise findings on the solution to the problem.

3) Have the teams discuss what actions must be taken to reach the solution that they have earlier agreed upon. They should keep notes about the activities that they think are necessary.

4) Distribute the handout -- Action Planning Worksheet. Instruct the teams to decide what activities are needed in their plans and enter them on the worksheet in the table given. Then, have them fill out the remainder of the worksheet items.

Be especially alert to the matter of measurement of results. If nothing can be measured, then it is not a reasonable solution to work toward.

All of the "WEEK" spaces on the Action Plan need not be used. On the other hand, if the tables, charts, etc., given are insufficient, the teams may add to them.

Planning Worksheet

Solution being used:

_____

_____

Activity	Week	Week	Week	Week	Week	Week	Week	Responsibility

How will results be measured?

_____

_____

Part 6 – Check Results

Monitoring the action plan once it is being applied is especially important. This is the process of checking or inspecting to be sure that the plan is being followed. It is also a means to locate new problems, failures or changes in the original problem situation and possible corrections in the plan being acted upon.

During the checking phase, assessments should be made of the action steps being taken. The following are important issues to be considered:

Timing -- Is each step being completed on schedule? If not, why not?

Results -- What were the results of each completed step?

Corrections -- What could be changed to move closer to the original intent?

Support -- What new or additional support, planning or problem-solving is needed?

Improvement -- How can it be done better the next time?

Checking results is a function of the group carrying out the action plan. In their periodic meetings, the issues above should be considered. All questions should be addressed and discussed. Agreement should be reached about each concern and how to resolve it. Responsibility for handling the matter should be defined.

The present case -- the cafeteria problem -- was structured to show all of the steps in systematic problem-solving. The case cannot show what actually happens in the checking results stage. This is a time, however, to pose questions of a "What if" nature. Problem-solving groups should anticipate possible failures. Consider, for instance, a manned space venture and the amount of time spent anticipating potential problems. This step, checking results, therefore, is essential to the entire systematic approach to problem solving.

Exercise 6

Title: Check Results

Purpose: To measure the effectiveness and status of each action step. To provide an indication of where additional support or planning is needed, or what new problems are blocking the completion of the action plan.

Time: 45 minutes.

Materials: Pens or pencils and paper. Handout: Results Check Worksheet. All other team handouts.

Procedure:

1) Assemble students into their teams

2) Discuss issues from the opening text.

3) Distribute Worksheets.

4) Compose a list of realistic, potential blocks to accomplishing the plans that the teams have made. (As instructor, you will have first-hand knowledge of their plans and the things that could happen to interfere with their accomplishment.) Below are some ideas to confront them with on a "What if" basis:

   The team member responsible for carrying out the third step in the action plan has had to leave school because of a family emergency. It is the third week of the plan. The other team members cannot find a replacement or volunteer right away. What is their course of action?

   A new principal takes over the school. He thinks discipline is the way to handle students. What does the team do to be constructive?

   The school budget has been cut. The principal has decided that to save kitchen staff time, he will adjust the schedule so that more students can be fed in a shorter period of time. What adjustments in the plan must be made?

   The vending machine company announces that it is increasing its service rates significantly. The principal decides that the school can do with fewer machines. How does this affect any planning?

   For some reasons, the old complaints about cleanliness and neatness in the cafeteria start to be heard. What does the team do?

   These are just a few possible themes for "roadblocks."

Results Check Worksheet

Solution being used:

Acitivity	Timing	Results	Corrections

Additional Support Needs:

How can we do it better next time (process)?

Part 7 – An Example Solution to the Cafeteria Problem

In order to help the reader visualize more clearly the problem-solving process proposed in the preceding Units, the following example solution is offered. The reader's perspective may differ from the text, but the important issue is observing the systematic problem-solving process in operation.

1. Define Problem

From the case study on Page 125, a number of facts appear. Cleanliness has declined over the past months; litter and trays have increased on the tables and floors, liquids have been tracked on the floors and the racks have been overcrowded. Further, the environment -- lighting and paint -- have been neglected.

Inspection of Pages 125-126 reveals a variety of issues. The conveyor is not working, therefore, "temporary" tray racks have been installed. The racks are not being cleared by cafeteria staff. The room serves more people than it has capacity for. The tables are all clustered in one half (or more) of the room, thereby restricting access to tray racks. Trash cans and racks are not uniformly distributed about the cafeteria at the exits.

There is a suggestion that more people eat in the cafeteria than those using the hot-food line; bags and papers are being left on the tables. If the room has a capacity of 100, and 110 use the serving line on the average, there is likely ample space over a one-hour period. If "brown baggers" also use the cafeteria space, the area must be overcrowded.

The following presentation is an example of an approach to the solution of the cafeteria problem. Different perceptions of the problem situation could lead to different contents, but not to a different solution process.

Notice that the problem is defined in a positive manner; that is, it states what is being done instead of what is not being done. For example, a person saying that he wants to stop smoking does not say what he wants to do otherwise. This is a negative statement, which indicates an idea of the direction in which the person wants to go, but as it stands it does not lead to problem solving. To say that the students are not putting away their trays and trash does not say what they are doing. From that statement, the students could be taking the trays and trash home with them. It is important for problem-solving purposes to frame positive statements about what is taking place.

2. Investigate Facts

Facts must be drawn from the case description and the setting diagram. Opinons, for example, referring to school pride must be set aside.

The Investigation Worksheet is an aid in organizing the facts.

Definition Worksheet – The Cafeteria Problem

1. State the problem as you see it now:

People are unhappy because students are leaving the cafeteria a mess.

2. Restate the problem using specific information: situation/object, action, location.

People eating lunch (object) in the cafeteria (location) are leaving (action) trays and trash on the tables and floor.

3. Does your problem statement have a specific:

Situation	**Yes** √	**No** ____
Action	**Yes** √	**No** ____
Location	**Yes** √	**No** ____

If you have answered "No" to any of the above, restate the problem.

Investigation Worksheet – The Cafeteria Problem

Problem Statement:

People eating lunch in the cafeteria are leaving trays and trash on the tables and floor.

What	**Changes?**	**Where**	**Changes?**
Cleanliness of cafeteria	Gotten worse	Cafeteria	No other places
When	**Changes?**	**Who**	**Changes?**
Lunch time	No time change	Diners: Students, faculty, staff, cafeteria area	None
How	**Changes?**	**Range**	**Changes**
Diners are leaving without removing trash and trays	Self-supervision	Over six months; confined to cafeteria staff, administrators	None
What objects are not having problems?		**Where, when is problem not occuring?**	
People who are not using the cafeteria; people leaving trays and trash		At times other than lunch	

Now that the facts have been collected, does the problem look different to you?

The diners could be staff and faculty, as well as students. Not all diners are leaving trays and trash behind. Perhaps trays are being left after the racks are full.

New problem statement, if needed:

Some students, faculty and staff eating lunch in the cafeteria are leaving trays and trash on the tables and floor.

3. Determine Cause

Seldom does a problem in a social setting, such as the cafeteria, happen because just one thiing went wrong or because one condition existed. The facts that have been collected from the case study can now be organized further in the form of a diagram to help visualize the interaction of people, things and events.

The items of concern are listed below, then placed into a floor diagram.

Material:

- Insufficient tray removal racks for exits
- Insufficient trash cans for exits
- Insufficient tables (?)

Environment:

- Cafeteria only
- Tables crowded into half of room space
- Access to racks hampered
- Malfunctioning machines
- Poor climate -- paint, lighting

People:

- Diners (students, faculty, staff) -- not cleaning up after themselves
- Cafeteria staff -- not clearing racks
- Administrators -- Cafeteria low priority for supervision and funding

Methods:

- Diners self-supervised
- Diners supposed to clear own trays and trash

Machines:

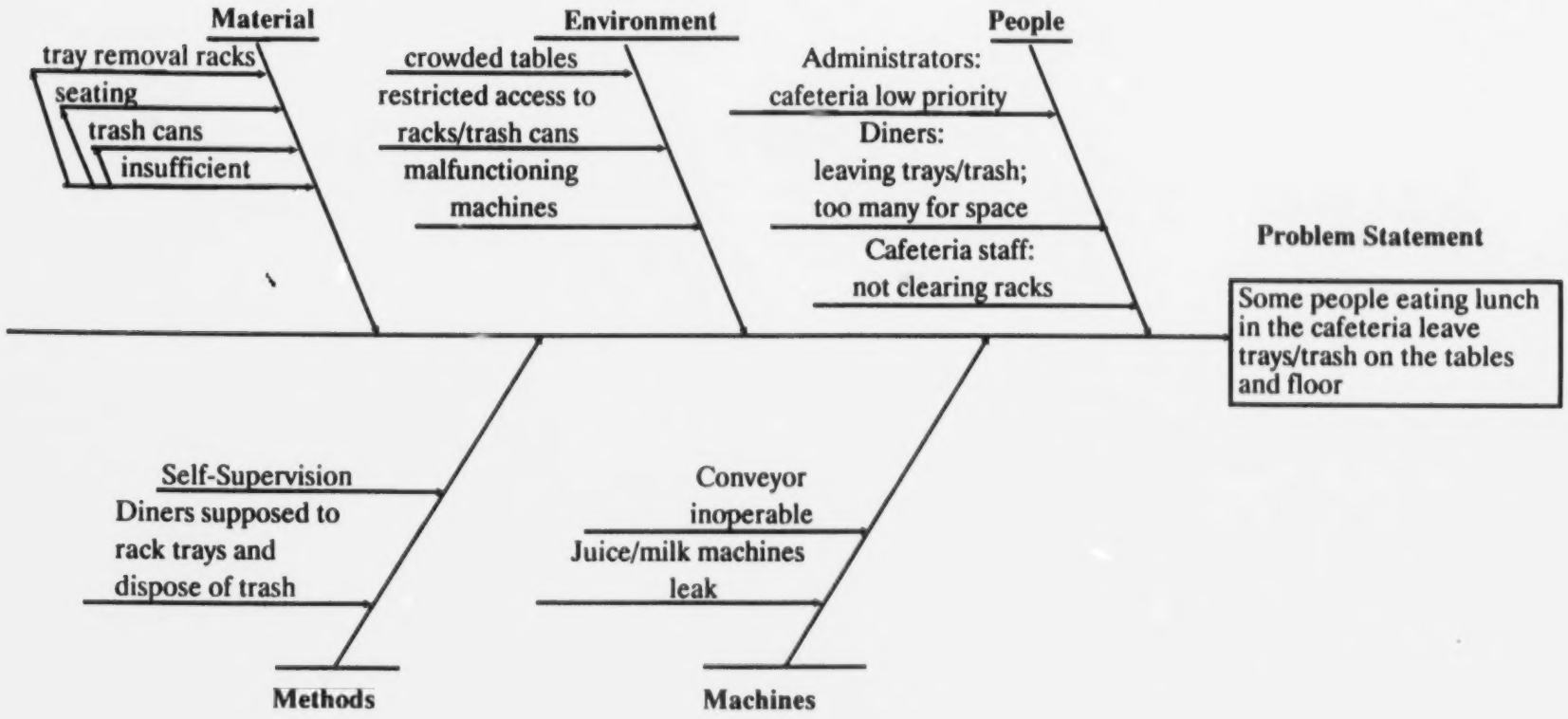
- Tray removal conveyor -- inoperable
- Liquid dispensers -- leaking

4. Generate Solutions

From the Cause Worksheet, some avenues of attach on the overall problem become apparent. It becomes clear, however, that the faculty/student committee cannot alone remedy all the issues.

We will assume that a group -- the faculty/student committee -- has brainstormed the problem situation. Biases certainly have come through their discussions. They have agreed, nevertheless, to look at short-term and long-term solution alternatives. The result is shown on the Solutions Worksheet.

Cause Worksheet – The Cafeteria Problem



Root Cause: Cafeteria setting inadequately arranged and furnished for number of diners.

Other Causes: Administration not supplying funds and priority to the cafeteria operation -- evidenced by lack of maintenance of machines and interior.

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Poor supervision of catereria workers.

Solutions Worksheet

Problem Statement:

Some people eating lunch in the cafeteria leave trays/trash on the tables and floor.

Cause Statement:

Cafeteria setting is inadequately arranged and furnished for the number of diners.

Step 1. State alternative solutions:

A. (Short-term) Arrange tables with more space between them and away from the exits. Relocate cans and racks. B. (Long-term) Repair equipment and machines. C. (Long-term) Increase cafeteria staff supervision and periodic clearing of racks. D. (Long-term) Upgrade setting -- paint, lighting.

Step 2. Discuss merits of all alternatives, noting significant pros and cons:

	Pro	Con
A.	Easy. No cost. Access to racks.	Labor.
B.	Eliminate need for racks; eliminate leaks/tracking.	Cost and budget.
C.	Clear racks for space; clean floors and tables.	Cost and supervision.
D.	Improve appearance and diners' attitude.	Cost and labor.

Step 3. Rate each alternative solution on a 1-10 scale using the four criteria listed below. A "10" rating is the most positive rating.

		Solutions				
		A	B	C	D	E
		Rating	Rating	Rating	Rating	Rating
1.	**Will it lead to long-term problem elimination?**	7	10	5	5	
2.	**Is it practical -- can resources be acquired?**	10	6	8	7	
3.	**Is it timely -- can it be done in the necessary time frame?**	10	7	8	6	
4.	**What is the probability of success?**	8	10	7	7	
	Total Rating	35	33	28	25	

Based on ratings and other discussion, specifically state the best solution:

Begin with alternative "A" (short-term) and work toward the longer-term alternatives

5. Plan Action

Once solution alternatives have been projected, a plan for implementing them is needed in order to continue with a systematic problem-solving procedure. It may be apparent now that the short-term solution alternative could be carried out by the faculty/student committee itself with some cooperation or coordination with the cafeteria management. The longer-term alternatives will require funds and support from the school administration which are out the control of the committee. (That issue was reflected in some of the lower ratings of the Solutions Worksheet. It is questionable to expect agreement from funding agencies for projects central to the problem solver's interests.)

6. Checking Results

After the plan of action is engaged, problem solving is not finished. Events may happen that offset or delay the established plan. These interferences need to be addressed in the same way as the overall problem. They need to be systematically recorded, and if necessary, the problem-solving sequence needs to be reintroduced.

Planning Worksheet – The Cafeteria Problem

Solution being used:

(Short-term) Rearrange and relocate tables, racks and trash cans. Then, (long-term) seek repair of the machinery, reassignment of the cafeteria staff for more floor service, painting and relighting of the room.

Activity	Week 1*	Week 2	Week 3	Week 4	Week 5	Responsibility
Plan action	X					Committee**
Plan evaluation	X					Committee
Present plan to principal		X				Committee chairperson
Conduct short-term action			X			Committee volunteers
Evaluate short-term action			X	X		Committee appointee
Identify funds for repairs, etc. with principal			X			Committee chairperson
Repair liquid dispensers				X		Committee appointee
Repair conveyor				X	X	Committee appointee
Paint, light cafeteria			X			Committee volunteers
Reorganize cafeteria staff with principal			X			Committee chairperson
Evaluate long-term efforts					X	Committee subgroup

*Specific dates should be entered.
**In each entry, a specific name or names should be given.

How will results be measured?

In each activity, the physical accomplishment of the task will be noted as either being done or not in the specified time period.

Results Check Worksheet – The Cafeteria Problem

Solution being used:

(Short-term) Rearrange and relocate tables, racks and trash cans. Then, (long-term) seek repair of the machinery, reassignment of the cafeteria staff for more floor service, painting and relighting the room.

Activity	Timing	Results	Corrections
Plan action	On time	Plan formulated	
Plan evaluation	On time	Plan formulated	
Present plan to principal	On time	Presentation made	
Conduct short-term action	On time	Rearrangements made	
Evaluate short-term action	On time	Assessment & evaluation made	Positive effects: easier access to racks, less trash
Identify funds for repairs, etc., with principal	Delayed	Administration unable to fund repair of conveyor	Seek other ways to raise funds
Repair liquid dispensers	Delayed 2 weeks	Administration requisitioning petty funds	
Repair conveyor	Delayed	Continue use of racks	Seek addition of more racks
Paint, light cafeteria	Delayed 1 week	Administration requisitioning petty funds	Arrange for volunteers to help maintenance staff
Reorganize cafeteria staff assignments with principal			
Evaluate long-term effects	On time	Plan executed & in operation except for finding funds to repair conveyor.	

Additional Support Needs:

1. Need financial commitment from the administration to fund maintenance of cafeteria.
2. Need members of the cafeteria management and the administration as members of the faculty/student committee.

How can we do it better next time (process)?

_____

_____

Supplementary Problem Definition Example

Case Study: The Customer Service Desk

Mike works at the customer service desk on the fifth floor of a large department store. His job includes four main responsibilities:

1) answering customer's questions.

2) giving directions for finding departments on all five floors of the store.

3) checking packages for customers.

4) selling tickets to entertainment events in the city.

Mike works with Mrs. Johnson, who is responsible for the customer service and mail order departments. Because she is busy answering the telephone and carrying out her other duties, Mrs. Johnson is seldom near the customer service desk. Since the late afternoon is a very busy time for Mike, customers must stand in line to buy tickets and pickup their packages.

Today Mrs. Hall, a long-time customer of the store, complained to Mrs. Johnson that she missed her ride home because she had to wait in line so long to pick up a package. Mrs. Hall also complained that Mike was short-tempered and discourteous to her. The fifth-floor manager is complaining because customers are kept waiting as long as 20 minutes after the store closes and he is getting tired of routing the late shoppers through the store to the exit and opening and locking the door several times each evening.

1) Underline all the important facts.

2) What is the problem here?

3) Examine the facts:
   WHO is involved?
   WHAT is happening?
   WHERE is the problem?
   WHEN does the problem occur?
   WHY has the situation become a problem?

4) Now that you have looked at the facts, can you state the problem better? (In the form of a question.)

Explaining Ideas

Write down the three ideas chosen by the class for solving the Customer Service Desk problem. Then think of at least one good point and one bad point for each idea. Write the good and bad points below each idea.

Idea:	
Good Points of Idea	**Bad Points of Idea**

Idea:	
Good Points of Idea	**Bad Points of Idea**

Idea:	
Good Points of Idea	**Bad Points of Idea**

Explaining Ideas

Idea: Close Customer Service desk 1/2 hour earlier.

Good Points of Idea	Bad Points of Idea
1. Customers out of store by closing time.	1. Inconvenience to customers.
2. No hassle for fifth floor manager.	2. Does not solve the problem of customers waiting in line.

Idea: Hire a person to help Mike in the afternoons.

Good Points of Idea	Bad Points of Idea
1. Better service to customers.	1. Costs money to pay another person.
2.. Decrease in Mike's workload.	
3. Speeds up service to customers.	

Idea: Mrs. Johnson could help Mike during busy hours.

Good Points of Idea	Bad Points of Idea
1. Better service to customers.	1. Mrs. Johnson would be taken away from other duties.
2. Mrs. Johnson could supervise Mike during this time	
3. Speedier service to customers.	

Supplementary Solution Evaluation Problem

Case Study: A Problem Between Friends

Jan Gray and Tim Moore have been friends since they were in kindergarten when the Grays became the Moores' next-door neighbors. Both Jan and Tim will be attending Gilford College in the fall so their friendship is likely to continue. It was also Time who introduced Jan to her steady boyfriend, Tim's best friend, Mike Alexander.

During the spring, Tim started working as a busperson at one of the nicest restaurants in town. He mentioned a number of times what a nice place it was to work and how much he was able to save for college because of the excellent tips. Tim knew that Jan wanted a job for the summer, so when he heard that Mr. Alberts, the manager, was accepting applications for summer help, he suggested that Jan apply as soon as possible. Because she applied early, Jan was hired and started working part-time and weekends as a waitress even before graduation.

Besides being able to save some money, Jan really enjoyed her job. The job was very different from anything else she had ever done. She enjoyed constantly meeting new people and the challenge of providing the best service she could. Mr. Alberts stressed the importance of teamwork and how each employee affected everyone else. Jan could clearly see what he meant. She was impressed by how cooperative and helpful everyone was. Being new, she especially appreciated the other employees' helpful suggestions and the way they occasionally gave her extra help if she was having problems organizing things.

About a month after Jan started, both she and Tim were scheduled to work the Saturday evening shift. In fact, hers was one of the stations Tim was assigned to bus. As she was taking an order, she noticed that as Tim was clearing the table next to her, he picked up the tip and stuffed it into his pocket. The policy was for waiters and waitresses to collect their own tips and turn them into the office. The tips were recorded, deductions were made, and then each person received a share as part of the weekly paycheck. At first Jan thought Tim must just be trying to clear the table as quickly as possible because it was so busy and that he planned to give the money to Gloria when he was finished. It was awfully busy so she didn't have time to give it much further thought -- at least not until much later that evening when she and Gloria were figuring their tickets and tips.

"Boy," sighed Gloria, "some people really have nerve!" I had three groups who didn't leave me one red cent. It wouldn't make me mad if I hadn't given them good service, but I did."

18 Adapted from *The Methods and Materials for Teaching Occupational Survival Skills*, R.E. Nelson, N.A. Flexman, J.A. Leach, and T.J. Scanlan. Illinois State Board of Education, 1978. Used with permission

"That's a rotten thing to have happen. I really am sorry."

"You ought to be, it affects all of us."

"It does, I hadn't thought about it that way."

It didn't take long to figure that Tim must be pocketing tips on a regular basis. Because they were such good friends, she felt she had to ask him about it. At first he didn't say anything, but finally he admitted that was exactly what he had been doing.

"Listen, Jan, I appreciate your concern that I'll get myself into big trouble. I'm glad you talked to me first and didn't go to Mr. Alberts. It won't happen again. I won't put you on the spot again. Let's just forget about it. OK?

That was fine with Jan, and she did just that. Then, about a week later they were scheduled to work together again. Though Jan didn't notice anything unusual, at closing several of the waiters and waitresses complained about being short on tips. They weren't just complaining about customers, they were beginning to suspect that "someone" was taking their hard-earned money.

Evaluating a Solution

1) Did the solution solve the problem? If not, why not?

2) Did the solution create any new problems? If so, what are they?

3) What steps need to be taken now to solve the new problem?

Part 8 – Evaluation

The unit on systematic problem solving is complex. It is important to be sure that the students grasp the intention of the six steps and that of systematic problem solving as a whole.

Exercise 7

Title: Student Evaluation

Purpose: To determine the degree to which the students have understood the problem-solving steps. To aid the instructor in identifying areas that may need review.

Time: One-and-a-half hours (perhaps over two sessions or begun in class and the remainder assigned).

Materials: Writing materials. Blank copies of the handouts from the preceding six exercises.

Procedure:

1) Assemble the students in their problem-solving teams.

2) Distribute the handouts.

3) Inform them that, as a team, they are to make up a case study along the lines of the one they have been working on. It should be simpler to save time. Then, they are to show how to solve the problem in their case study using the six systematic problem-solving steps and the worksheets provided.

4) Set a deadline.

5) Review several of the completed studies with the whole class.

Exercise 8

Additional Case Studies for the Problem-Solving Unit:

Use the six-point problem-solving method on the following case studies.

1) A warehouse outlet sells to customers over the counter. In order for a customer to buy an item, he or she fills out a form after looking at products in display cases or catalogs.

At several of the outlets, an unusually large number of customer complaints have been received in the past two months. These complaints have been to the managers and clerks. They pertain to receiving and paying for wrong items or having the desired items out of stock, which then have to be ordered and the customer waits for days or weeks. The volume of customers has increased remarkably in the showrooms; the staff has remained the same. The company was making clear profits, but the complaints have had an effect. Sometimes there are many customers waiting for service. Business should be excellent. The prices of the goods are very competitive.

The customer service process is the following: 1) the customer fills out an order form and gives it to a clerk at the service desk; 2) the clerk punches the order item number(s) into a computer -- which calls up the item(s) from the inventory and also deletes the number of items requested from the inventory; 3) the clerk's request appears on a monitor in the warehouse and an order is printed; 4) the printed order is given to a warehouse worker, who searches for, gathers and brings the item(s) to the warehouse clerk; 5) the warehouse clerk checks the printed order against the item(s) brought to the warehouse desk; 6) the warehouse clerk places the item(s) on a conveyor belt which feeds back to the showroom clerk; 7) the showroom clerk, in the meantime, collects payment for the order; and 8) the clerk delivers the order to the customer.

The customer service process has been arranged to be self-regulating without supervision -- or at least with minimal management. The company pays minimum wage for its clerks until they show six-months employment, then incentive pay begins per item sold. To help reduce the press of more customers, the company has employed new computer programs for its customer service and inventory processes.

Managers of the failing offices are eager to identify the cause or causes of the customer complaints.

2) A fast-food delivery service in a college town promises to deliver foods to customers within 30 minutes or the cost will be cut by half. The service makes pizzas and Italian foods for delivery. It will, as well, buy foods from other fast-food restaurants for delivery at a moderate cost.

The location of the business is in northern Indiana in a generally prosperous community. Claims -- half prices -- have increased in December and January. February is not looking good for profit.

There are two company-owned delivery vehicles. Eight others are owned and operated by the delivery people. That is, the employees who deliver the products own and use their personal cars. In those situations, the drivers get a mileage allowance.

The orders from customers usually come by telephone to the "dispatcher." That person relays the order to the cooks. For other fast foods, the dispatcher calls a deliveryman directly and instructs him or her of the order, the cost and the address of the customer. Foods made by the restaurant are delivered following the same procedure.

The owner and the manager of the business are concerned, because since summer they have had to pay the "half price" penality increasingly. It has nothing to do with the quality of the food. Orders have increased. Delivery has been impaired, especially between 8 and 11 p.m.

You have been asked to help to diagnose the situation to remedy this seeming decline in profits.

Part 9 – Descriptive Tools in Problem Solving

Small and large companies have and will continue to bring computers and statistical tools into their day-to-day operations. As competition in business increases, more workplaces are making decisions based on information and data. Along with having the skill to perform their office or factory functions, employees have to collect and analyze data to improve their work. They are expected, as well, to be able to understand and interpret very basic ways to organize data, analyze it and display it.

This section of the text, Part 9, has three subsections that are intended to familiarize students with basic skills needed to work in a new data-based work setting. Part 9a provides tools for organizing and displaying data. The techniques for organizing data are common to a variety of industrial and educational situations. Part 9b goes beyond organizing and displaying data; it concerns basic data analysis. Part 9c illustrates a practical application of the preceding parts.

(Part 9 carries out an organizational theme similar to that of the previous parts. In this part, however, informational content and exercises are not separated. The format will be essentially the same for each exercise.)

Part 9a – Charts and Graphs

This lesson will help you learn to summarize information on a chart or graph. The type of chart or graph you use depends upon the type of summary you develop. Some charts compare or contrast information, some show trends, and some show proportion. All are easy to construct and will aid you as you learn to communicate in this easy and efficient manner.

Information displayed on charts or graphs is easy to read. It enables the reader of the chart or graph to quickly grasp the situation and understand the meaning of the displayed data. Charts and graphs help shorten and make the sharing of critical data more precise and more efficient.

There are a variety of charts and graphs, but basically, they can be classified as:

1) Pie Charts
2) Bar Charts
3) Line Graphs

These types of charts and graphs summarize information, show trends, and compare information.

Part 9a – Exercises

Title: Charts and Graphs

Purpose: To be able to organize and display data in a way that increases student understanding and application for data-based thinking.

Time: One hour. (Note: The exercise on pie charts, presented here, requires personal data collection over a school day. The exercise, however, could be modified.)

Materials: Writing materials. Straight edge. Copies of the materials on pie charts, bar charts and line graphs.

Procedure:

1) Introduce the background and rationale for using charts and graphs.

2) Proceed through the materials on pie charts, bar charts and line graphs, as they are presented.

3) Discuss issues as they arise.

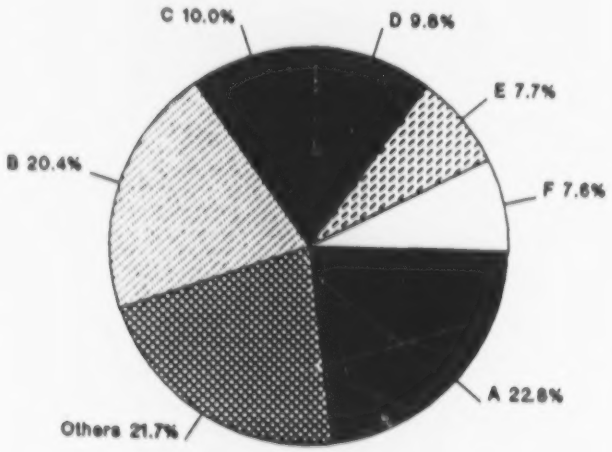
4) To determine that the students grasp the use of charts and graphs, engage the students in a variety of activities, e.g.:

   Assign them the task of developing a chart or graph relevant to their classroom work part-time job.

   Generate a list of possible ways they presently could use charts or graphs in their day-to-day classroom or work settings. Try out some of the ideas on the list collectively or in subgroups. Show and discuss the results.

Pie Charts

Pie charts help the reader look at a point in time or to look at a "snapshot" of a situation. The following is an example of a pie chart and production output.



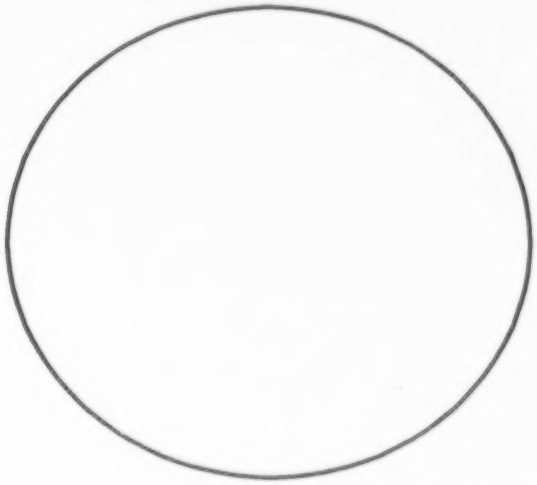
There are several advantages to a pie chart:

- Shows all or 100 percent of the information
- Shows the percentage of each component by the pie segments
- Easy to read
- Easy to construct

Application Exercise

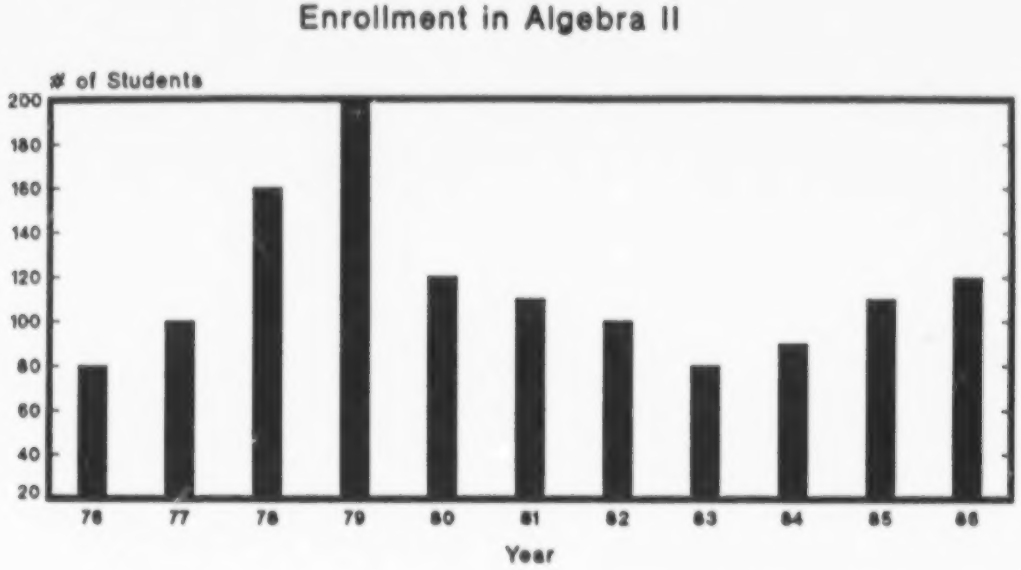
INSTRUCTIONS: You want to take a close look at how you spend your time at work each day. Gather information on how you spend your time hour by hour and how much time you spend on each activity. Categorize your activities into at least seven categories. Compute each category by percentages. Draw your pie chart.

Daily Activities



Bar Charts

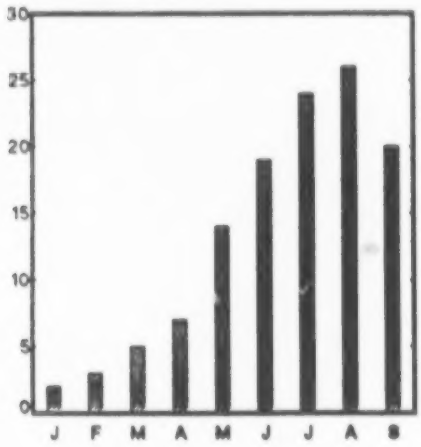
Bar charts are useful to make multiple comparisons. Note on the chart below the comparison is the number of students enrolled in Algebra II by year.



There are some simple construction techniques to keep in mind if you develop your chart by hand.

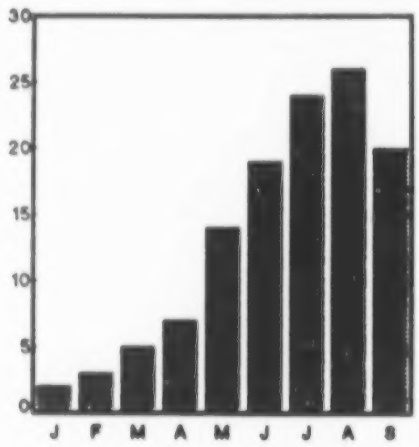
CORRECT:

Chart where the ratio of bar width to bar space is 1:1.



INCORRECT:

Chart where the ratio of bar width to bar space is 6:1.



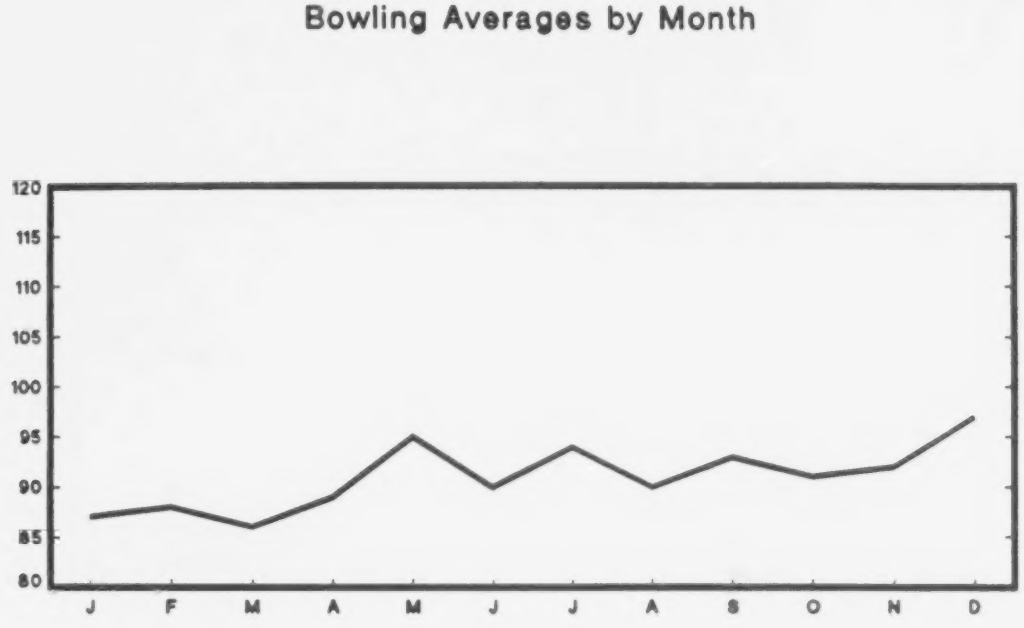
Application Exercise

Develop a Bar Chart to track the number of students absent by month in 1987.

Jan.-----40
Feb.-----50
Mar.-----43
Apr.-----38
May-----59
June----52
July-----55
Aug.-----44
Sept.----42
Oct.-----63
Nov.-----45
Dec.-----58

Line Graphs

Line graphs help the reader see trends or information as it develops over time. The following is a line graph of a bowler's monthly bowling averages. A general improvement trend is noted.



Application Exercise

Develop a Line Graph to track the school budget over the past decade.

1977--2.5 million
1978--3.2
1979--3.5
1980--3.9
1981--3.5
1982--4.0 million
1983--4.5
1984--5.0
1985--7.0
1986--8.3
1987--9.2

Part 9b – Introduction to Basic Statistics

By gathering and organizing data, we can make decisions that are based on fact rather than opinion. Therefore, our decisions have a greater chance of being correct, if they are backed by factual evidence. Compare: "something seems peculiar here..." to "I drew three samples of 20 and found..." By making fact-finding tools a part of our daily work or problem-solving efforts, we can regularly monitor processes and put our opinions "in touch" with fact.

Part 9b – Exercises

Title: Introduction to Basic Statistics

Purpose: To show the student the need and use for basic statistical techniques.

Time: One hour.

Materials: Writing materials. Copies of the materials on frequency distribution, range, mode, median and mean of a distribution.

Procedure:

1) Present the rationale for understanding and being able to carry out basic statistical techniques.

2) Distribute the content and application materials on frequency, range, mode, median and mean.

3) Proceed through the portions of the content and applications as they are organized in the text.

4) Discuss issues as they arise.

5) Try to assess the students' grasp of these basic statistics by relating them to classroom grading. Use a particular test or assessment from the past (excluding names). Demonstrate a frequency distribution of the grades or scores. Have them find the range, mode, etc.

   Raise the question of other uses of such statistical data.

Frequency Distribution Chart

A frequency distribution chart is a tool for organizing raw data. The chart consists of three columns. Column one has the discrete, different scores or measures. In the example below, test scores are listed under the "Score" column. Under the "Tally" column are check marks for each time a student had the particular test score. The "Frequency" column lists the number of tallies for each test score.

Test Scores

Score	Tally	Frequency
83	/	1
84	/	1
85	///	3
86	///	3
87	///	3
88	////	4
89	/////	5
90	////////	8
91	/////	5
92	/////	5
93	///	3
94	//	2
95	//	2
96	//	2
97	/	1
		48

Application Exercise

A teacher is monitoring the time it takes for students to complete a math quiz. Organize the data in a RANK ORDER and TALLY fashion. Use the chart below.

Time is in minutes.

07	06	07	08	07	04
05	09	09	05	07	10
11	07	06	09	06	11
08	04	08	04	08	10
03	05	06	07	10	03
08	08	05	06	12	01

Time	Tally	Frequency
01	/	1
02		
03		
04		
05		
06		
07		
08		
09		
10		
11		
12		

Range of a Distribution

The range is a measure of dispersion. It shows the total span or spread of a distribution. It measures the amount of difference between the two most extreme values in the distribution. For example, the range of test scores for the following distribution is shown below.

Test Scores

Score	Tally	Frequency
83	/	1
84	/	1
85	///	3
86	///	3
87	///	3
88	////	4
89	/////	5
90	////////	8
91	/////	5
92	/////	5
93	///	3
94	//	2
95	//	2
96	//	2
97	/	1
		48

----------Range 14----------

83----------97

The range is a quick indicator of how disperse the scores or measures are in a distribution.

Application Exercise

What is the range of the following test scores:

1) 100, 80, 7, 60, 45, 22?

   Range =

2) 100, 88, 90, 77, 95, 83

   Range =

3) What do the ranges of #1 and #2 tell you about the dispersion of scores for these two sets of test scores?

Mode

To further describe a distribution of scores, it is often useful to understand what score or measure occurs most often. The "Mode" is the score or measure that occurs the most times in a frequency distribution. The mode score has the most tally marks beside it. In the example below, the test score that occurs most frequently is 90. Thus, 90 is the "Mode" of this distribution.

Test Scores

Score	Tally	Frequency
83	/	1
84	/	1
85	///	3
86	///	3
87	///	3
88	////	4
89	/////	5
90	////////	(8)
91	/////	5
92	/////	5
93	///	3
94	//	2
95	//	2
96	//	2
97	/	1
		48

Application Exercise

For the distribution below, organize the data into a frequency chart and circle the mode.

RAW DATA: 111, 110, 111, 109, 107, 106, 111, 115, 112, 115,
116, 110, 111, 109, 108, 105, 112, 115, 116, 111

SCORE	TALLY	FREQUENCY

What potential insights into a distribution does the "Mode" provide?

Median of a Distribution

It is often useful to understand what score value falls in the middle of a distribution of measures or scores. The Median provides this information. In order to calculate the median, the individual scores are listed from smallest to largest as indicated below. The number halfway between the smallest and largest is the "Median" value.

EXAMPLE 1

AGE DISTRIBUTION

Larry---33
Joe-----32
Jane----32
Frank--29--MEDIAN
Mary---28
Tom----20
Sam----12

EXAMPLE 2

AGE

Barry------45
Carol------42
Alex-------49
George----39
Bob--------39--MEDIAN
Ray--------39
Samantha-30
Leslie-----28
Ralph-----20

If an additional member is added to Example 1, the two middle most values are added together (Bob & Frank) and divided by 2.

Larry---33
Joe-----32
Jane----32
Bob-----31--
30 = MEDIAN
Frank---29--
Mary----28
Tom-----20
Sam-----12

Application Exercise

For the distribution below, calculate the Median.

80
75
70
70
70
68
65
64
63
60

What is the potential advantage of understanding the median of a distribution?

Mean of a Distribution

One of the most useful descriptive statistics of a distribution is the "Mean." The "Mean" is the average score of the distribution. It is sometimes written as $\overline{X}$ read "X bar." The $\overline{X}$ is the sum of all scores divided by the number of scores in the distribution. The "Mean" or average for a distribution is calculated by the following steps.

1) Multiply each score by its frequency.

SCORE			FREQUENCY
5	×	4	= 20
4	×	4	= 16
3	×	6	= 18
2	×	5	= 10
1	×	1	= 1
		20	65

2) Add the "score × frequency" = 65

3) Divide the sum of the "score × frequency" by the number of items in the frequency column.

$$\overline{X} = \frac{65}{20} \qquad \overline{X} = 3.25$$

Application Exercise

For the distribution below, calculate the Mean.

SCORE	FREQUENCY	SCORE × FREQUENCY =
13	2	
12	4	
10	6	
8	1	
5	3	
4	5	
2	2	
	___	
TOTAL =		

Why is it useful to understand the mean of a distribution?

Part 9c – Practical Application
Statistical Process Control

Process Control -- Background

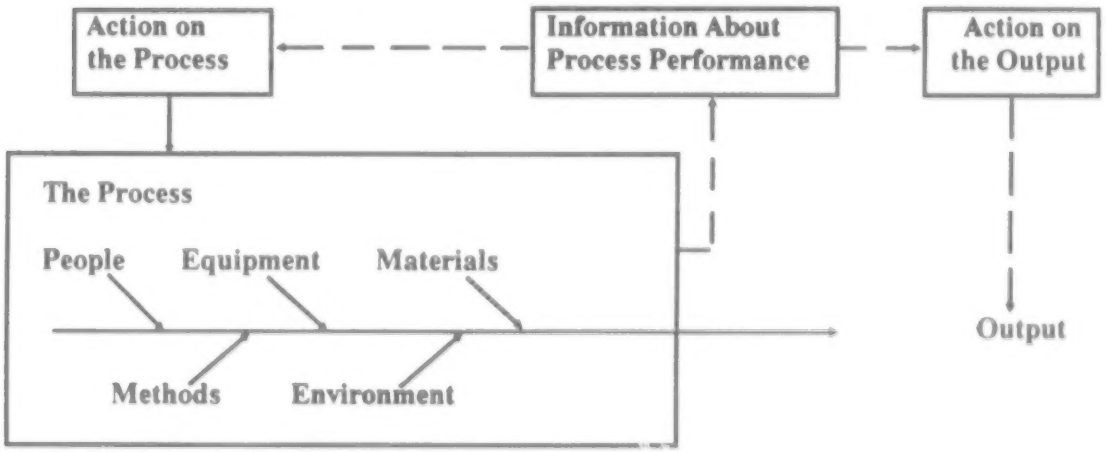
Earlier in this unit, comments were made about the increased placement of problem-solving and decision-making requirements on production operators and line workers. A growing body of literature shows that this is the case. The thinking behind this strategy -- versus leaving all decisions to management -- is clear and sound.

Ford Motor Company, one example, has recognized that "older" methods relying on administrative action to solve production problems, still leads to the production of faulty goods. This approach rests upon analyzing products that are complete, but containing error. Such methods can take much time; in that time more faulty products come off the line costing the company, and of course, the customer.

Much more efficient is the prevention of the production of ineffective goods -- whether cars or can-openers. Preventing error in production is greatly affected by modifying the process of production, not the outcome alone. Ford data indicate that at least 15 percent of production errors can be corrected by those directly involved in the production process -- the line operators.

To accomplish reducing process errors mentioned above, workers themselves must become attuned to monitoring their own procedures. The more predictable and error-free procedures are at each production station, the more efficient the process as a whole. To picture a process control system, we can look back earlier in the problem-solving part of this unit for a model that we can add to. Figure 14 illustrates a process control system.

Figure 14. A Process Control System



The process is a very complex interaction among all of the people, elements, parts and surroundings that combine to produce something. Paying attention to what is produced, output, forecloses on remedying failures in the process before the process produces more failures. Gathering information about process performance, however, while the process is in motion enables action on the process, which then affects the immediate output. Action on the output may have to continue until problems in the process have been corrected.

Although the main emphasis above is made toward manufacturing processes, the same concepts are equally applicable to office procedures, communications processes, etc. Being certain that customer orders are entered into a computer system without errors is the same as insuring that manufactured parts remain within the design tolerances.

Control Charts

Control charts are decision-making tools. There is no magic in them. Their value depends on the care with which observations are made of elements in the production process. The observations, therefore, must be planned and systematic. The data that form the decision-making input are means (averages, $\bar{X}$) and ranges (R): topics that were introduced earlier and are among the most basic ideas in statistics.

Three elements are involved in the development and use of control charts:

Data collection: Specific measures must be taken of features of the process in question (dimensions of machined pieces, numbers of flaws on a bolt of vinyl, transit times, number of bookkeeping errors).

Control limits: Limits are calculated from the data collected above. From these, the stability and variation in the process being studied can be assessed.

Problem solving and decision making: Once the data above have been plotted on the control chart, problem-solving groups have a basis for determining the adequacy of production and operations at specific points or stages in the process.

The steps relate directly to the early parts of the problem-solving model presented earlier -- information gathering and investigation. In the exercise that follows, we will look closely at the first two steps of constructing a control chart. Then, we will try to see some of the features of the line graphs that may point to problems and what those problems may be.

Part 9c – Exercise

Typically, a control chart contains four major groups of information and data.

Identifiers: Where the measures are being made, what is being measured, who is making the measurements, when the measures are being taken.

Chart of averages ($\overline{X}$) of the measurements.

Chart of ranges (R) of the measurements.

Measurement readings and averages.

Control charts can be quite large. An example of a portion of one is shown in Figure 15. For our purposes, the chart will be broken down into two more easily managed sections: one containing the readings (raw data) and the averages chart, the other with the readings and the ranges chart.

Title: Control Charts

Purpose: To demonstrate the application of simple, basic statistical procedures to an industrial problem-solving situation.

Time: One to one-and-a-half hours.

Materials: Pencils, straight edge, scratch paper, handouts of the averages and ranges control charts, the Basic Calculations Worksheet and the Control Limits Worksheet.

Procedure:

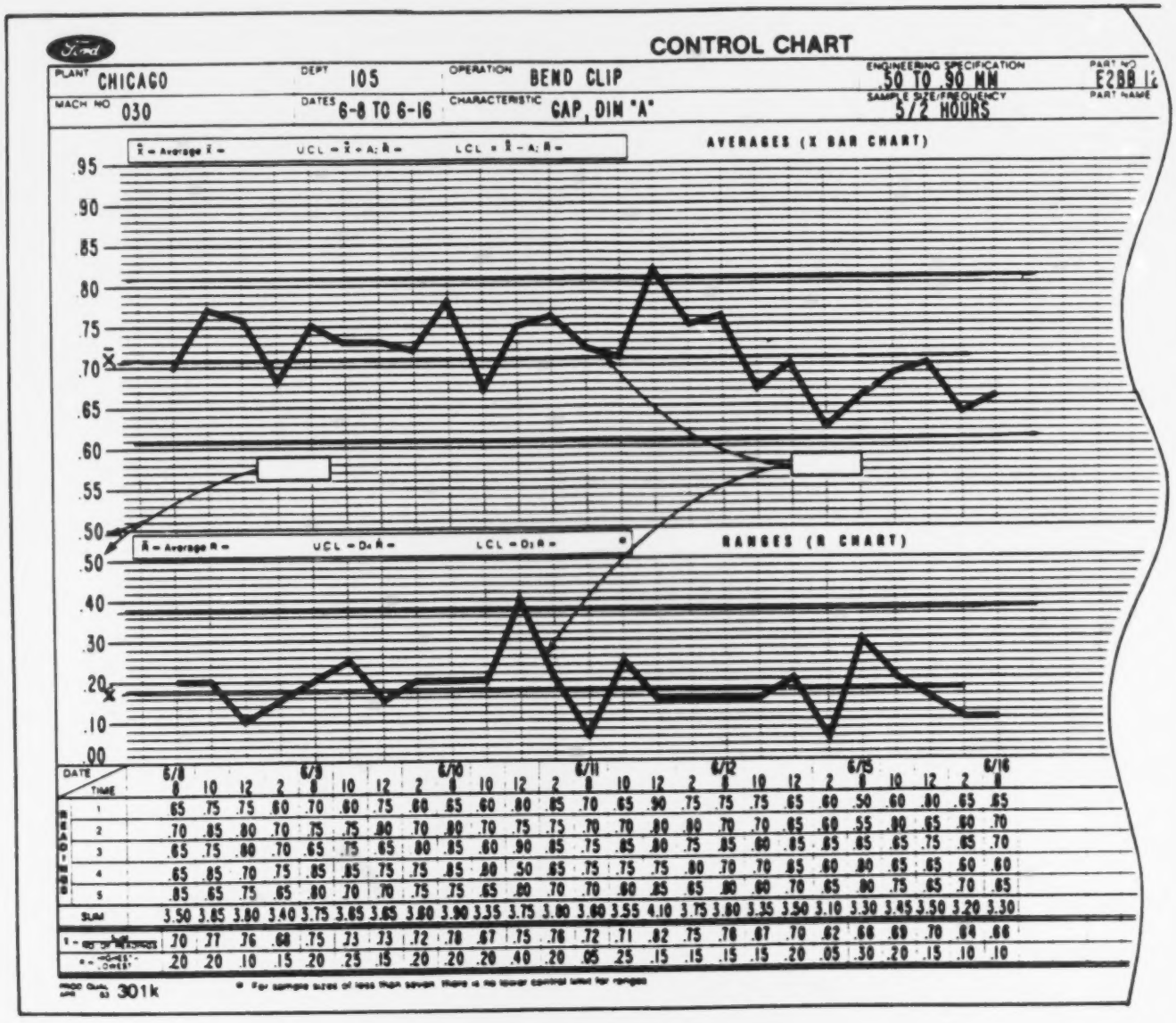
1) Present to the students the introductory information given at the beginning of this subunit.

2) Review, if necessary, the statistical concepts of an average or mean and a range.

3) Describe the problem setting:

"You have been rotated to a production line that produces a bent clip used to hold upholstery linings. The design specifications for the gap between ends of the clip require that they be between .50 and .90 mm apart. Because you are a new operator at this station, you have been asked to collect some samples of the clips and test the gap spacing.

Figure 15



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"You are to collect and measure five clips four times a day at 8:00 and 10:00 a.m., at 12:00 noon and at 2:00 p.m. You are to record your readings (measurements) for each clip, find the average gap dimensions each hour and determine the range of gap dimensions each hour.

4) Distribute the Basic Calculations Worksheet. Give the students time to find averages and ranges.

   $\overline{X}$ = sum of measurements/number of measurements
   R = highest measurement – lowest measurement

   Check to be certain that all students have the same values for the averages and ranges.

5) Distribute the Averages and Ranges Control Charts. Inform the students that the day they have just made calculations for is the first day of readings in the data section: that means and ranges are all provided.

   The vertical scales reflect average gaps in mm and the range of measurements in mm.

6) Have the students begin plotting the points on the chart for averages first. It is better to use pencil than pen. They may then connect the points. Repeat the procedure for ranges on the range chart.

7) The line graphs on each control chart should be the same as those in Figure 15. Only the slopes of the lines should differ, but the point locations and relationships should be the same.

   These two line graphs themselves do not give much information for problem solving as they are, because there are no reference points or guidelines.

8) Distribute the Control Limits Worksheet. Have the students determine the:

   Average of the averages ($\overline{X}$)
   $\overline{X}$ = Sum of the averages/Number of averages*

   Average range ($\overline{R}$)
   $\overline{R}$ = Sum of the ranges/Number of ranges**

   * 17.90/25 = .716
   ** 4.45/25 = .178

   Half of the class, perhaps, could do averages, the other half ranges.

Have the students draw these averages on their charts using solid lines. Now there is an initial reference line. We need more reference information. We cannot tell yet if the troughs and peaks in relation to the averages are too high or too low. Limit lines are needed.

9) To determine the upper and lower control limits, we must rely on some work done by statisticians to save us time. Here is part of a table of factors that are needed. These factors are a combination of sample size and variations in range. They do not have to be calculated again and again.

Sample Size:	2	3	4	5	6	7	8	9	10
Factors:									
A	3.27	2.57	2.28	2.11	2.00	1.92	1.86	1.82	1.78
B	0	0	0	0	0	.08	.14	.18	.22
C	1.88	1.02	.73	.58	.48	.42	.37	.34	.31

The sample size (per hour) is five (5) in the example being used.

Upper Control Limit for Range = $A \times \overline{R}$ = .376
Lower Control Limit for Range = $B \times \overline{R}$ = 0
Upper Control Limit for Averages = $\overline{\overline{X}} + (C \times R)$ = .819
Lower Control Limit for Averages = $\overline{\overline{X}} - (C \times R)$ = .613

Have the students determine the control limits and draw these on their charts. Use dotted or dashed lines for the upper and lower limit lines. Be certain that their calculations match those above.

10) Be certain that there is closure at this point and that the control charts are uniform among the class members.

Discussion Questions:

- What does any one point on the range control chart mean? (It indicates the variety, dispersion or spread of measurements taken at that day and time.)
- What does any one point on the averages control chart mean? (It indicates the most common or central measurement value of the measurements taken at that day and time.)
- Why are there no points on either line graph on the average line? (Averages are made up of many measurments or scores. They do not exist. If a measurement is right on the average value, it is unusual. Averages simply give an idea of the center of any group of things that can be measured in some way.)

- Why take so many samples? Wouldn't it be just as good to take 20 clips a day at 10:00 a.m.? (Refer back to Figure 14 and complexity of a process.)

Should you break the instruction here or at an earlier time, be certain that the charts are saved for the next discussion.

Basic Calculations Worksheet

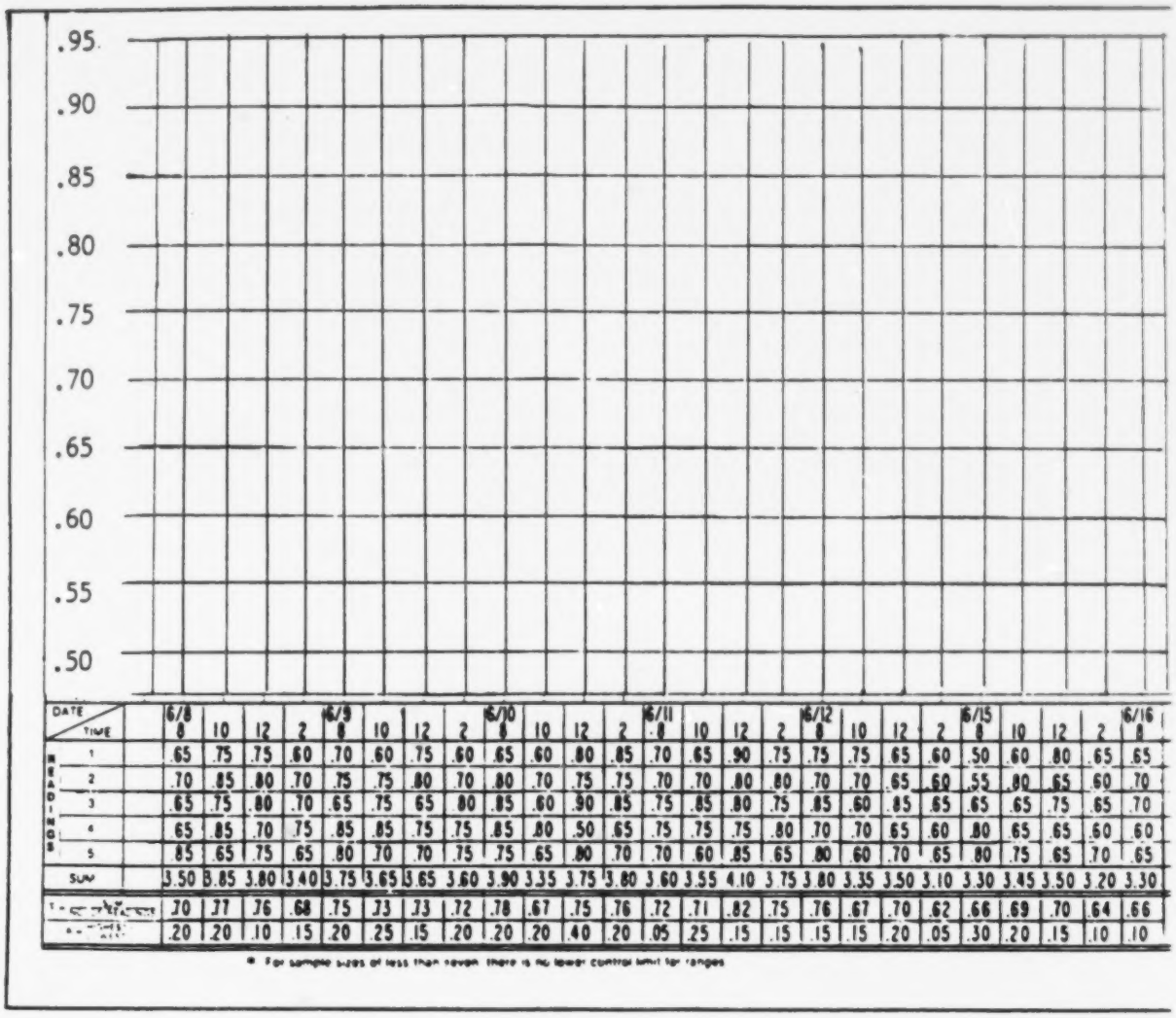
You have been assigned to make the readings that were described earlier. That is, on each day choose five clips at four different times: 8:00 and 10:00 a.m., noon and 2:00 p.m. Below are the readings (measurements) that you have made on the width of the gap on each clip in mm. Total these four columns to find the sums. Then, find the averages and ranges for each column. which is the sample for each hour.

Date		6/8			
Time		8	10	12	2
Readings:	1	.65	.75	.75	.60
	2	.70	.85	.80	.70
	3	.65	.75	.80.	.70
	4	.65	.85	.70	.75
	5	.85	.65	.75	.65
Sum					
Average $(\overline{X})^*$					
Range (R)**					

* Average = Sum/Number of Readings

**Range = Highest Reading – Lowest Reading

Averages Control Chart



DATE / TIME		6/8 8	10	12	2	6/9 8	10	12	2	6/10 8	10	12	2	6/11 8	10	12	2	6/12 8	10	12	2	6/15 8	10	12	2	6/16 8
READINGS	1	.65	.75	.75	.60	.70	.60	.75	.60	.65	.60	.80	.85	.70	.65	.90	.75	.75	.75	.65	.60	.50	.60	.80	.65	.65
	2	.70	.85	.80	.70	.75	.75	.80	.70	.80	.70	.75	.75	.70	.70	.80	.80	.70	.70	.65	.60	.55	.80	.65	.60	.70
	3	.65	.75	.80	.70	.65	.75	.65	.80	.85	.60	.90	.85	.75	.85	.80	.75	.85	.60	.85	.85	.65	.65	.75	.65	.70
	4	.65	.85	.70	.75	.85	.85	.75	.75	.85	.80	.50	.65	.75	.75	.75	.80	.70	.70	.65	.60	.80	.65	.65	.60	.60
	5	.85	.65	.75	.65	.80	.70	.70	.75	.75	.65	.80	.70	.70	.60	.85	.65	.80	.60	.70	.65	.80	.75	.65	.70	.65
SUM		3.50	3.85	3.80	3.40	3.75	3.65	3.65	3.60	3.90	3.35	3.75	3.80	3.60	3.55	4.10	3.75	3.80	3.35	3.50	3.10	3.30	3.45	3.50	3.20	3.30
[illegible]		.70	.77	.76	.68	.75	.73	.73	.72	.78	.67	.75	.76	.72	.71	.82	.75	.76	.67	.70	.62	.66	.69	.70	.64	.66
[illegible]		.20	.20	.10	.15	.20	.25	.15	.20	.20	.20	.40	.20	.05	.25	.15	.15	.15	.15	.20	.05	.30	.20	.15	.10	.10

* For sample sizes of less than seven there is no lower control limit for ranges

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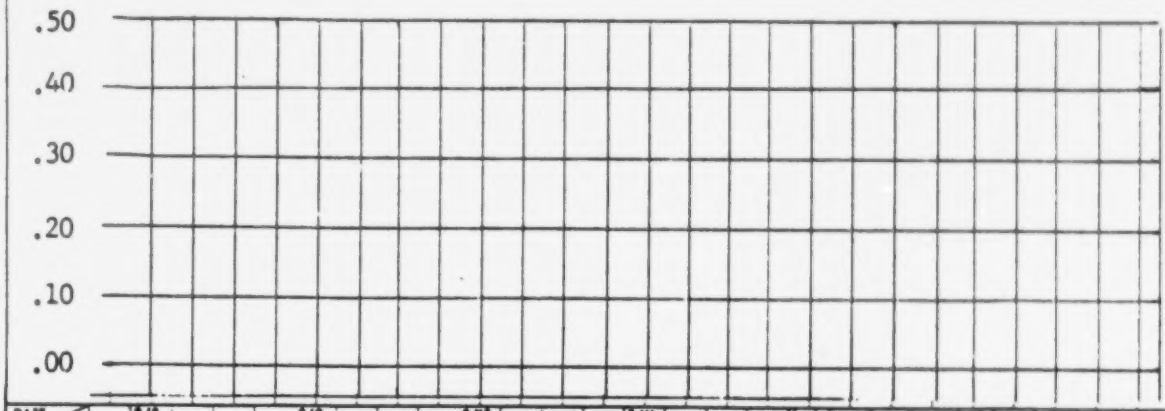
Ranges Control Chart



DATE		6/8				6/9				6/10				6/11				6/12				6/15				6/16
TIME		8	10	12	2	8	10	12	2	8	10	12	2	8	10	12	2	8	10	12	2	8	10	12	2	8
READING	1	.65	.75	.75	.60	.70	.60	.75	.60	.65	.60	.80	.85	.70	.65	.90	.75	.75	.75	.65	.60	.50	.60	.80	.65	.65
	2	.70	.85	.80	.70	.75	.75	.80	.70	.80	.70	.75	.75	.70	.70	.80	.80	.70	.70	.65	.60	.55	.80	.65	.60	.70
	3	.65	.75	.80	.70	.65	.75	.65	.80	.85	.60	.90	.85	.75	.85	.80	.75	.85	.60	.85	.85	.65	.65	.75	.65	.70
	4	.65	.85	.70	.75	.85	.85	.75	.75	.85	.80	.50	.65	.75	.75	.75	.80	.70	.70	.65	.60	.80	.65	.65	.60	.60
	5	.85	.65	.75	.65	.80	.70	.70	.75	.75	.65	.80	.70	.70	.80	.85	.65	.80	.60	.70	.65	.80	.75	.65	.70	.65
SUM		3.50	3.85	3.80	3.40	3.75	3.65	3.65	3.60	3.90	3.35	3.75	3.80	3.60	3.55	4.10	3.75	3.80	3.35	3.50	3.10	3.30	3.45	3.50	3.20	3.30
* - [illegible]		.70	.77	.76	.68	.75	.73	.73	.72	.78	.67	.75	.76	.72	.71	.82	.75	.76	.67	.70	.62	.66	.69	.70	.64	.66
** - [illegible]		.20	.20	.10	.15	.20	.25	.15	.20	.20	.20	.40	.20	.05	.25	.15	.15	.15	.15	.20	.05	.30	.20	.15	.10	.10

* For sample sizes of less than seven there is no lower control limit for ranges

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Control Limits Worksheet

In order to have the line graphs on the averages and ranges control sheets mean anything, there must be reference points. Only with such points can we tell if problems exist or whether the operator is doing a good job -- or if there is an equipment problem.

First, it is necessary to find the average of the averages and the ranges.

The average of the averages ($\overline{X}$) = the sum of the averages/number of averages
$\overline{X}$ = .7275

The average of the ranges ($\overline{R}$) = the sum of the ranges/number of ranges
$\overline{R}$ = .1625

Draw lines on your averages and ranges charts according to your calculations. Label them $\overline{X}$ and $\overline{R}$.

Second, to help most of all with problem solving, we should know what the limits are for best production. To find these limits, we need the information from above and some from a table that has already been set up for us. (The table contains factors about range differences and sample sizes.) Below is part of that table:

Sample Size:	2	3	4	5	6	7	8	9	10
Factors:									
A	3.27	2.57	2.28	2.11	2.00	1.92	1.86	1.82	1.78
B	0	0	0	0	0	.08	.14	.18	.28
C	1.88	1.02	.73	.58	.48	.42	.37	.34	.31

What is the sample size in the readings that were taken?
Circle that sample size and the factors below it.

Finding the upper and lower limits for averages and ranges is very simple.

Upper control limit for range (UCLR) = $\overline{R} \times A$ UCLR = .3705

Lower control limit for range (LCLR) = $\overline{R} \times B$ LCLR = 0

Upper control limit for averages (UCLX) = $\overline{X} + (C \times \overline{R})$ UCLX = .846

Lower control limit for averages (LCLX) = $\overline{X} - (C \times \overline{R})$ LCLX = .6088

Draw these lines on your averages and ranges charts. They should show a band above and below the $\overline{X}$ and $\overline{R}$ lines.

Analyses and Interpretations from the Control Charts

Statistics is very much concerned with random and non-random happenings. A statistician is just as interested in a situation, say, recording occasional errors in word processing (random occurrence) as in noting a trend toward more or fewer errors (non-random).

Statistical process control, then, centers greatly on detecting random and non-random happenings on production lines, office settings, etc. If the average ($\bar{X}$) and range ($\bar{R}$) line graphs "dance" slightly back and forth across the average ($\bar{X}$ and $\bar{R}$) lines, the process is **in statistical control**. That is, all of the many parts of the process (See Figure 14) are balancing each other; the process is running smoothly. On the other hand, if a trend occurs away from the average line in either direction, the process is **not in statistical control**, but perhaps understandable in the process system. Such trends require attention to see what is causing this non-random activity. Teachers and parents do something like this all of the time. If the classroom or children's room keeps a constant, expected noise level, the teacher or parent can go about his business. When the noise level shifts up or down, that is a signal to investigate.

Turning to the control charts, it becomes clearer that they are a way to look for signals that deserve attention and possibly a problem-solving action. One central concern of this approach is determining the causes of marked changes or trends. If the averages or ranges lines remain within the upper and lower control lines, it is likely that some factor or factors in the process are causing the behavior of the line and can be brought into control. If averages or ranges lines go outside the control lines in either direction, then it is almost certain that some factor outside the process is the cause.

Analysis of the charts begins with the ranges chart. It centers on points within and outside the control lines -- the points outside the limit lines being of the more immediate concern.

It is very important to note that in every instance that patterns, trends, points exceeding the limit lines, etc., appear in the data on the charts, the first course of action is to check for miscalculation or misplotting of the point(s). Additionally, it is equally important to determine if the measurement system changed in some way -- a different observer or inspector, or a large different gauge or standard used. In other words, before a large amount of energy is used to try to solve a problem, the indicators must be accurate and valid.

Data plots beyond the control limits on the Ranges Chart:

1) A point above the upper control limit indicates that the spread has broadened -- worsened.

2) A point below the lower control limit shows that the spread of the distribution has decreased -- improved.

In the example problem (refer to Figure 15) the point at 6/10, noon, was beyond the upper control limit. This must be examined immediately. External causes may be operating; this could indicate an eventual trend.

There were no points below the .00 limit, which is not possible. The point at 6/12, 2:00 p.m., approached the lower limit. It would be advisable to try to find out what was happening then, because the data show that the clips were more uniform in measurement -- a desirable situation.

Patterns or trends within the control limits:

Runs (significant trends) are shown when there are seven or more points in a row on one side of the average line -- or seven points in a row that are increasing or decreasing in relation to the preceding point.

1) Runs above the average line suggest an increasing spread in product measurements. This could happen because of equipment malfunction or a change to less uniform materials. These can be corrected within the process and need to be acted upon.

2) Runs below the average line signify a lessening of the spread of differences in the product. These should be studied for wider application; they are positive indicators.

Our example contains no runs, although between 6/11, noon, and 6/12, 10:00 a.m., there are four identical points in a row which should be noted for future observations.

Obvious non-random patterns:

Examples of non-random patterns are trends, cycles, periodic clusters of points or consistent relationships among points (such as, the first daily reading always being higher). Patterns are not always easy to see. Further, care should be taken not to overinterpret the data.

There is a test for the overall spread of data points. That is the spread of points from $\overline{R}$. About two-thirds of the data points should lie in the middle third of the region between the control limits (around $\overline{R}$). About one-third should be in the outer regions nearer the limit lines. This would reflect a random distribution.

1) If substantially more than two-thirds of the data points lie close to $\overline{R}$, the measurements have been taken on two or more different, but comparable items (e.g., one item drawn from each bin).

2) If substantially fewer than two-thirds of the points lie close to $\overline{R}$, the samples contain measurements of items that vary greatly (e.g., mixed lots of raw materials).

In the example used here, about two-thirds of the data points fall near the average line.

When the ranges, which reflects variations and spread of measures, are within expected guidelines, the process is considered to be stable (in statistical control). The averages can then be studied to see if the process is changing over time.

Points beyond the control limits on the Averages Chart:

Points beyond either control limit show an effect of some factor outside the process in question. The process has shifted for some reason either as an isolated event or as part of a trend. This signals the need for immediate analysis.

Our example showed one point (6/11, noon) exceeded the upper control limit. Although this situation calls for study, it should be noted that this was a single event and was the beginning of a downward trend. It is likely that points will get closer to the average from such an extreme, but the ranges chart gives some interesting information. Following the peak, the next four data points drop. On the ranges chart, the readings for those same times and days were constant. There was stability in the process; the averages of the measurements were returning to control. The issue is to find out why.

Patterns or trends within the control limits:

Unusual patterns or trends can be evidence of lowered or no control or change in the process.

Runs, as above, are indicated by seven points in a row on either side of the average line or by seven points in a row that are increasing or decreasing.

The time the trend or shift began is important to tie in with other factors. A run parallel with the average is usually a sign that the average is changing or that the measurement methods have changed.

In our example, a run by the definition above does not occur, but from 6/12, 10:00 a.m., to the end of the observational period are eight consecutive points below the average line. One point approaches the lower control limit. This information, plus that of the downward trend from from the maximum peak, strongly suggests that the process has changed in some way. The situation definitely calls for study.

Obvious non-random patterns:

Distinct patterns, such as trends, cycles, unusual spread of points within the control limits and relationships among measures among the samples indicate non-random events. The same test may be applied to averages as to ranges. That is, two-thirds of the points should lie in the middle third of the region between the control limits around the average line.

The interpretation for more or less than two-thirds of the points falling in the middle third of the region between the limits are the same as those for the ranges chart.

In the case of our example, only slightly more than one-third of the points lie in the undesignated zone. This suggests non-control of the process under study.

Conclusion

This presentation on the use of simple statistical methods to develop a problem-solving aid could become more elaborate in the interpretation area. Enough examples have been given to show the value of the control charts. Of course, the interpretations are based on experience. Increasingly, the line worker is contributing not only to the data collection, but to aiding in the interpretations.

It is important to remind the reader that all of the control chart data began with simple measurements -- measuring the gap space on a clip. The measurement values were added and divided by their number to get an average. A range of measurement values was obtained by subtraction of the lowest value from the highest. The averages and ranges led to a valuable problem-solving tool -- the control chart. Not one operation went beyond basic arithmetic. Yet, the "real world" application and use of these basics tend to get set aside.

Teachers, students and administrators must become aware of the growing importance of bringing basic learnings of language and mathematics into application in the working world. Industries, businesses and services expect more and more of it. They are expecting more and more in the area of human relations skills, such as group problem-solving. Manual skill alone is decreasing in importance.

To quote from a Ford Motor Company publication on statistical process control (See References):

> It should be emphasized that problem solving is often the most difficult and time-consuming step. Statistical input from the control chart can be an appropriate starting point, but other simple tools such as . . . charts, . . . diagrams or other graphical analysis can be helpful. Ultimately, however, the explanations for behavior lie within the process and the people who are involved with it. Thoroughness, patience, insight and understanding will be required to develop actions that will measurably improve performance. (Page 18.)

Part 9c – Supplemental Exercise 1

The problem situation and configurations are identical to that of the preceding problem. These data have been collected from a different assembly line.

Follow the same steps in the analysis of the data. Determine averages, ranges, control limits, etc. Plot the averages and ranges data. Analyze the line graphs.

Additional Materials: Graph paper

Sampling Data Table:

Date	6/8				6/9				6/10			
Time	8	10	12	2	8	10	12	2	8	10	12	2
Reading												
#1	.65	.75	.60	.60	.70	.75	.75	.60	.65	.60	.80	.85
#2	.70	.85	.75	.70	.75	.80	.80	.70	.80	.70	.75	.75
#3	.65	.75	.75	.70	.65	.80	.65	.80	.85	.60	.90	.85
#4	.65	.85	.85	.75	.85	.70	.75	.75	.85	.80	.50	.65
#5	.85	.65	.70	.65	.80	.75	.70	.75	.75	.65	.80	.70
Sum	3.50	3.85	3.65	3.40	3.75	3.80	3.65	3.60	3.90	3.35	3.75	3.80
X-Bar	.70	.77	.73	.68	.75	.76	.73	.72	.78	.67	.75	.76
R	.20	.20	.25	.15	.20	.10	.15	.20	.20	.20	.40	.20

(Table continued:)

Date	6/11				6/12				6/15			
Time	8	10	12	2	8	10	12	2	8	10	12	2
Reading												
#1	.65	.70	.90	.75	.75	.75	.80	.65	.65	.65	.50	.60
#2	.70	.70	.80	.80	.70	.70	.65	.60	.70	.65	.55	.80
#3	.85	.75	.80	.75	.85	.60	.75	.65	.70	.85	.65	.65
#4	.75	.75	.75	.80	.70	.70	.65	.60	.60	.65	.80	.65
#5	.60	.70	.85	.65	.80	.60	.65	.70	.65	.70	.80	.75
Sum	3.55	3.60	4.10	3.75	3.80	3.35	3.50	3.20	3.30	3.50	3.30	3.45
X-Bar	.71	.72	.82	.75	.76	.67	.70	.64	.66	.70	.66	.69
R	.25	.05	.15	.15	.15	.15	.15	.10	.10	.20	.30	.20

Part 9c – Supplemental Exercise 2

Suggestions to Instructors:

Apply the data collection process from the Ford Motor Company to a classroom, lab or workshop situation. Use the data to construct graphs of averages and ranges -- with control limits and averages.

Bring the process into another reality! The measures to be recorded can be whatever is relevant -- not just millimeters, but feet, numbers of motions, numbers of errors, etc. (e.g., number of errors in wordprocess in first week of training).

Part 10 – Developing Additional Exercises

In developing exercises for this unit, the following themes should be considered:

Justification: Participative, systematic problem solving requires that all members of a group (no matter what kind) be able to express themselves. Decisions arrived at by a group lead to stronger affiliation among group members; they all have contributed.

Information: Information is generated in a group by all members offering their ideas, experiences and opinions. The likelihood that a problem will be solved effectively depends greatly on the pool of information that the group develops.

Motivation: Members of a group who do not participate in systematic problem solving are left having to go along with the results generated by the others. Non-participation in the process is yielding a role in the course of the group. The personal determination not to participate usually leads to complaints, dissatisfaction and apathy.

Those who do contribute to a group decision retain influence and control over the problem-solving process and direction.

Expected Outcomes: Knowledge and skill in applying a systematic problem-solving model is one result of the training. The understanding of how problem solving occurs in a group medium is the other desired outcome.

Some suggestions for activities to emphasize the points made above:

- Examine and compare interviews with individuals who did and did not vote in an election (a group decision).
- Analyze the factors that are rewarding in systematic problem solving. What factors are discouraging or frustrating?
- Analyze group members' actions and attitudes that positiviely and negatively affect systematic problem solving.
- Apply a case study to several individuals and a group. Compare the outcome of problem solutions from the individuals versus the group. Analyze the differences, if any, between individual solutions and the group solution.

Part 11 – References on Systematic Problem Solving

Adams, J. L., *Conceptual Blockbusting*, Third Edition, Reading, Mass.: Addison-Wesley, 1986.

Adams, J. L., *The Care and Feeding of Ideas*, Reading, Mass.: Addison-Wesley, 1986.

Beckhard, R., and Harris, R., *Organizational Transitions*, Reading, Mass.: Addison-Wesley, 1977.

Brandt, S. C., *Strategic Planning in Emerging Companies*, Reading, Mass.: Addition-Wesley, 1982.

Continuing Process Control and Process Capability Improvement, Statistical Methods Office, Operations Support Staffs, Ford Motor Company, December 1984.

Fryor, Marsdill, *Successful Problem Solving*, National Textbook, 1979.

Introduction to SPC, Technicomp, 1985.

Osborn, A., *Applied Imagination*, New York: Chas. Scribner's and Sons, 1953.

Polya, G., *How to Solve It*, New York: Doubleday, 1957.

"Puzzles or Problems? Cutting Through the Manager's Dilemma," *Business Horizons*, vol. 28, May-June, 1985, p. 69.

Shermis, Samuel, and Barth, James L., "Problem Solving and the Social Studies," *Education Digest*, vol. 50, Nov. 1984, pp. 33-35.

Slife, Bernard, and Cook, Ruth E., "Developing Problem Solving Skills," *Education Digest*, vol. 51, Feb. 1986, pp. 50-54.

Wickelgren, Wayne A., *How to Solve Problems*, W. H. Freeman, 1974.